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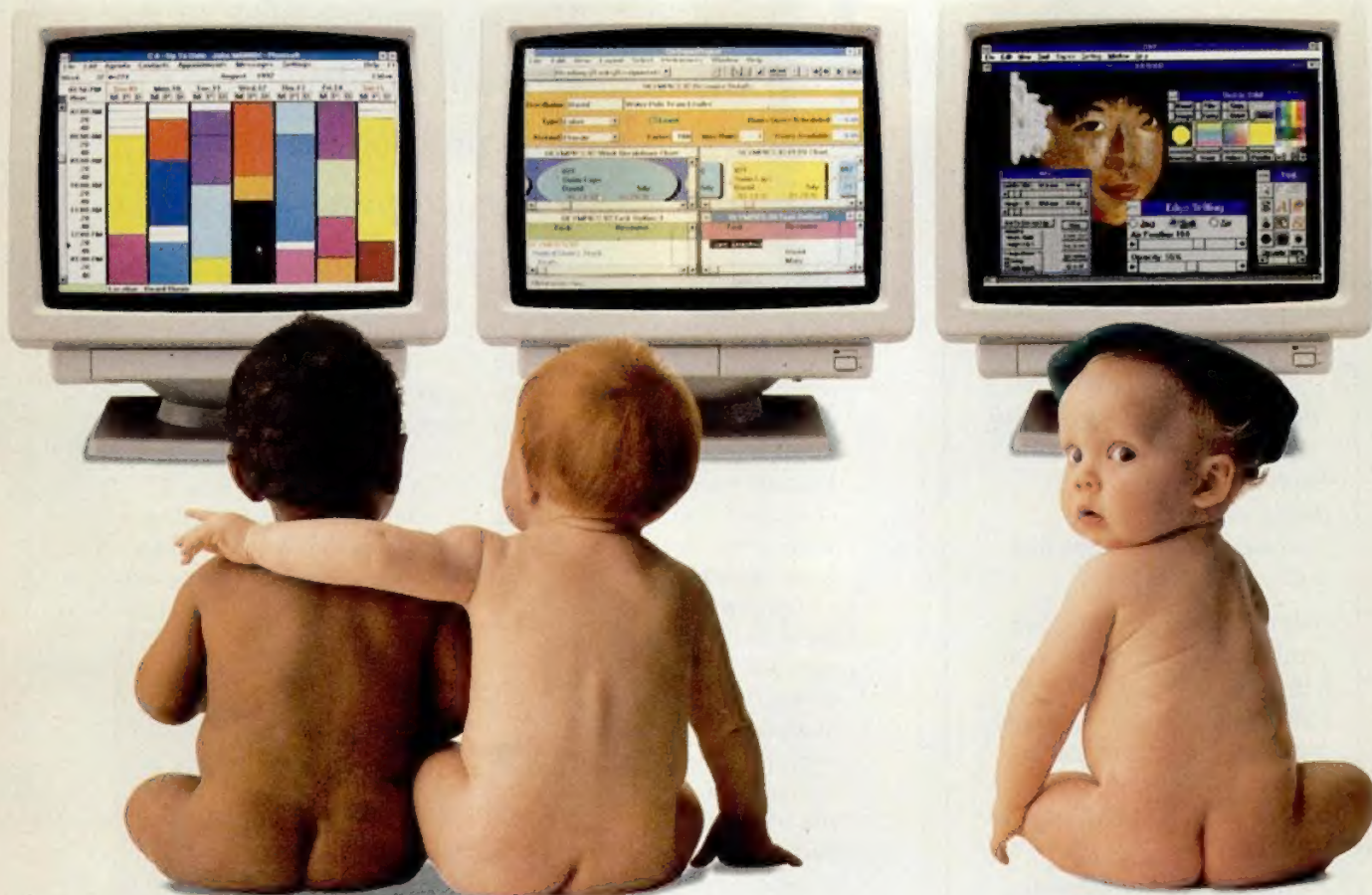
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CIRCLE 263 ON READER SERVICE CARD

Inside

Our cover story in this issue is about low-cost PCs. We keep coming back to the same theme, which has dominated this industry (and is probably unique to it): As products gain power, they get cheaper. A 486/25, which has become to

today's buyer the standard purchase that an IBM PC AT was just five years ago, is five to ten times as powerful as that 1987 workhorse. More remarkable is that the average price of such low-end machines has remained at around \$2,000 as we have worked our way up from the AT to 486 models.

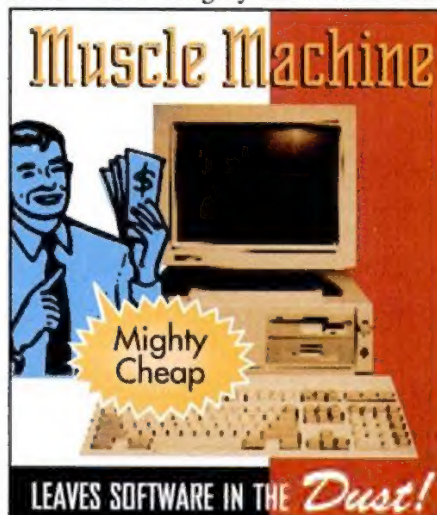
Bargain prices have placed a lot of power on our desktops, but what are we to do with it? We have complained for years that software has not caught up with hardware, and that's still true. After the introduction of the 386, we had to wait more than five years for a decent 32-bit operating system: OS/2.

These days, Microsoft is trumpeting its upcoming Windows NT as the technological Second Coming. Dare we tell those folks we really needed it in 1987?

The intersection of computing power and advances in software development has brought benefits. We hear less grumbling about the slowness of graphics programs. On a 486/50 or 486DX2/66 with a graphics accelerator and a fast hard disk, Windows even comes close to having snap. Multitasking has also be-

come a routine matter. Some of us run a word processor in one window, read network e-mail in another, and download files from an on-line service in a third without much thought about the way an AT would have stumbled.

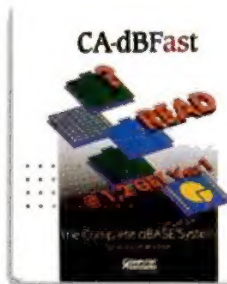
Our CAD story in this issue, "2-D Drafting: Why Pay More," shows that even a venerable software category can benefit from



innovation and more computer power. We are beginning to see Windows CAD programs and OS/2 CAD programs, but our reviewers tell us they are not necessarily better than DOS-based software. In an industry obsessed with the new, it's always good to be reminded that we have to differentiate between innovation and progress.—Joel Dreyfuss

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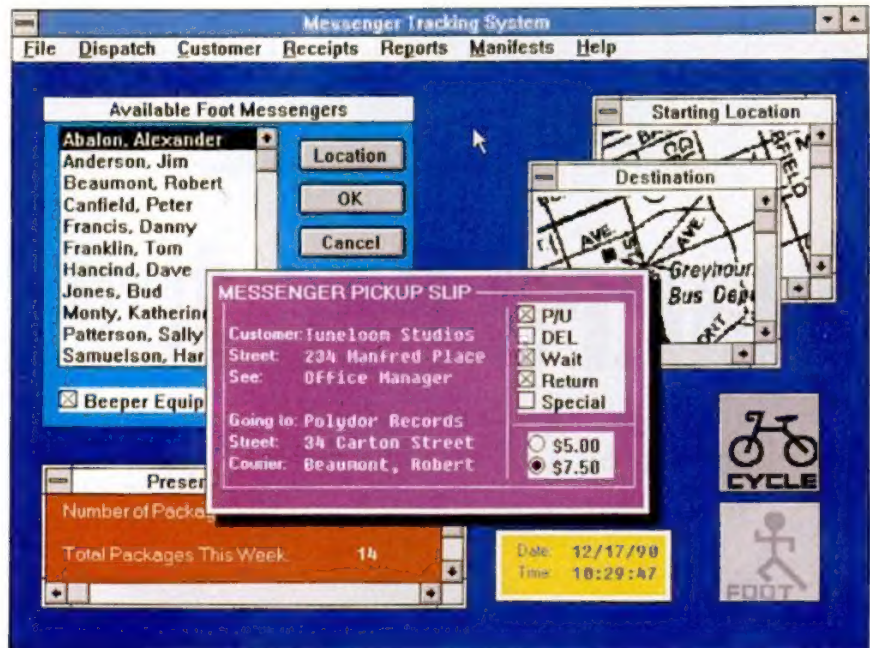


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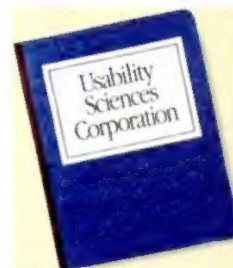


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Low-Cost, High-Feature PCs

BY PETER LEWIS These full-featured PCs reflect a current trend: squeezing maximum value from under-\$2,000 price tags. PC Magazine Labs has tested 61 competing systems. Some came with surprises, and some with compromises.....110



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Computers are today's best tax-time tools (page 225).

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2-D Drafting: Why Pay More?

BY JEFF PROSISE While \$2,000 and \$3,000 CAD packages still have their uses, you can get away with spending only \$200 or \$300 for most 2-D drafting tasks. *PC Magazine* looks at 22 2-D drafting software products across the price spectrum to help you decide how much—or how little—you'll need to pay255

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On-line services promise a world of information
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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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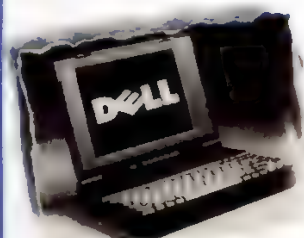
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CIRCLE 071 ON READER SERVICE CARD

According to Mr. Magoo, there's no trick to spotting a reliable monitor. You just pick one from a manufacturer that has met the stringent ISO 9000 series of standards for quality. And displays the ISO 9000 seal. The way Samtron does.

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Their high rating means that, with the possible exception of advertising, they approve of what Samtron does. The way we train our people. The way we keep our records. Our management. Our delivery. Our overall product quality. About the only thing they weren't quite sure of was Magoo.

Gads, Two New Flat-Screen Monitors.

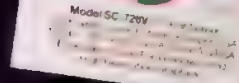
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Letters

PRINTER BLOCKBUSTER

While I found your Ninth Annual Printer Issue (November 24, 1992) informative and useful, I feel that your treatment of gray-scale capabilities could have been better. The impact on graphics quality of both the new gray-scale features found on some mainstream laser printers and the higher resolution available on others is not at all clear from your reviews or the accompanying print samples.

Unfortunately, your print samples all appear to have the same 75-dot-per-inch graininess and no noticeable change in the number of shades. Somehow it seems that the graphics software you used didn't do justice to the new gray-scale capabilities.

*Peter Thieberger
Brookhaven, New York*

A point needs to be brought up regarding your reader survey on printer satisfaction: There is no mention of how much throughput each respondent's printer produced monthly or annually. Without this factor being taken into account, the number of instances when the printer needed repair isn't very meaningful.

*Billy Pogue
Lake Havasu City, Arizona*

Your excellent printer issue had one major omission. You emphasized that prices of laser and ink jet printers were only a few hundred dollars higher than those of dot matrix printers, yet the cost of consumables is barely mentioned.

At the current cost of 1 cent per page for dot matrix consumables (versus the current cost of approximately 7 cents per page for laser and ink jet consumables), the dot matrix printer is about \$3,000 cheaper to operate—even if we presume only 50,000 pages will be produced in its lifetime.

*John Hamaker
Laguna Niguel, California*

Your annual issue on printers defies ordinary adjectives, as usual. May I just call it "super" and let it go at that?

*Barbara Hunter
Westbury, New York*



*"Your annual issue on
printers defies ordinary
adjectives."*

UPGRADING PROBLEMS?

I have been reading your magazine for a number of years and have noticed a disconcerting trend. More often than not, when reviewing PC hardware, it seems that your Editors' Choice is given to a product that is far beyond the financial means of most of your readers.

In "Upgradable PCs" (December 8, 1992), your Editors' Choice—the Compaq Deskpro M—was more expensive than the car I drive.

*Thomas D. Tharp
Oak Park, Illinois*

The cover story in the December 8 issue of *PC Magazine* was a disappointment. It was not a disappointment because the article lacked facts or information, but because the article, which was billed as "Upgradable PCs," actually did not describe how to go about upgrading your computer.

The article was solely directed at people who want to evaluate how upgradable a computer is before making a buying decision. Please begin to consider spending a little more time helping readers get the most from the equipment they already own.

*Richard B. Laimbeer
New York, New York*

• The story included a sidebar, "486 Upgrade Alternatives," which explained how to upgrade a system by using various plug-in cards or by replacing the motherboard.

You should also look at "The Perfect PC" (July 1992), in which we evaluated several PC components to help you figure out which would be best to use in upgrading your system.—Ed.

PC MAGAZINE IS READ EVERYWHERE!

Bill Machrone's column "Through a Glass, Darkly" (December 8, 1992) did a fine job of pinpointing the advantages of having *PC Magazine* on paper rather than on-disk. Aesthetics, random access, and subliminal cues are all good points, but Machrone did miss some more obvious benefits.

Not only is reading from paper more visually comfortable, it also allows readers to circle important tidbits and lay out several issues at a time for cross-referencing. But most importantly, who has a CD-ROM in their bathroom?

*James Corpening
Plantation, Florida*

BREAKING UP IS HARD TO DO

I would like to comment on Michael Miller's column "Break Up Microsoft?" (December 8, 1992). Government anti-trust laws are for the purpose of protecting the public.

Please remember the great favor our government did by forcing Kodak to give up the rights to sell film with processing included, along with its secrets of film processing. As a result, the cost of film has increased, while the quality of processing and service has decreased.

Hopefully, we will be able to keep the government away. The potential breakup of Microsoft will not help us in the long run.

*Ken Peters
Merritt Island, Florida*

TAXING TAX LAWS

John C. Dvorak's "Inside Track" (November 24, 1992), mentions that 20 different tax packages calculated the tax due in a very complex scenario provided by

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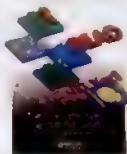


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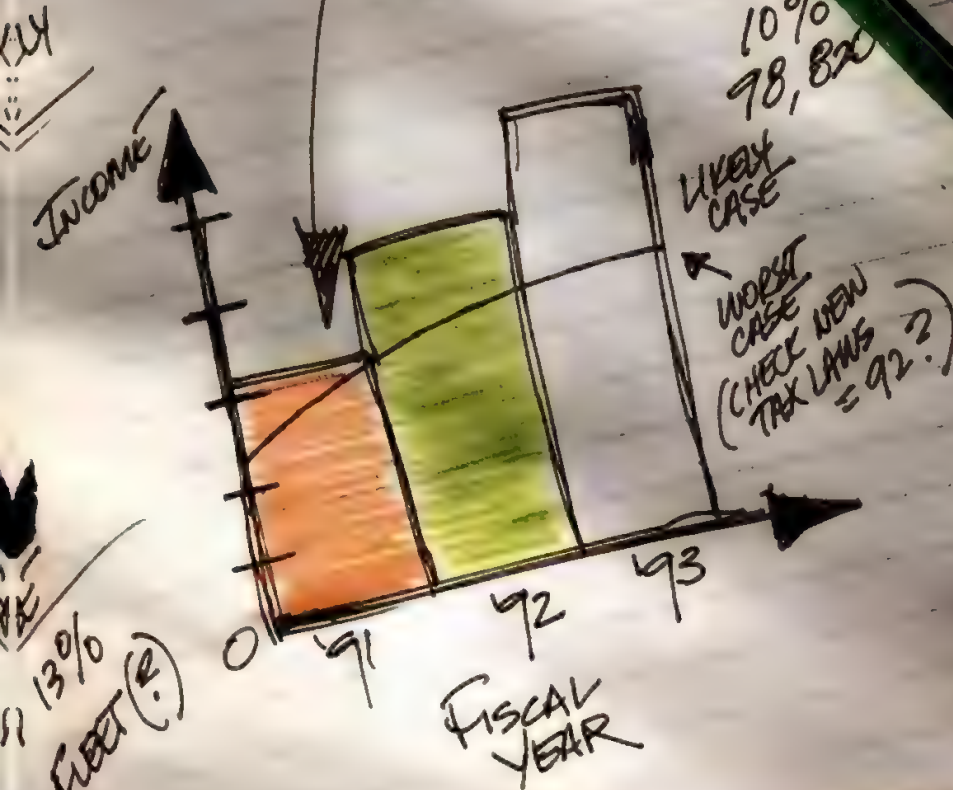
PROJECTED INCOME STATEMENT

INVEST
TAX INCOME
REAL TAXES
INCOME

FY 91
1,884,400
480,710
1,403,690
477,255
926,435

FY 92
2,072,840
519,423
1,553,417
528,162
1,025,255

EXTEND



ASSUME:
INFLATION = 8%
(ADJUSTED)

13%
NEW FLEET (?)

84,866
528,162
56,164



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LETTERS

The CPA Software News, and that each package came up with a different answer. There are a few good reasons for this discrepancy. The preparers were inconsistent in how they handled subjective choices; they had little training on the packages and input some parts of the problem inappropriately. Also, the software differed in some assumptions. The law is vague on so many aspects of this scenario that if you were to ask 20 accountants or IRS agents to prepare the return manually, you would also get 20 different answers.

The scandal doesn't lie with the tax software, the accountants, or the IRS, but with an unintelligible tax law.

John Graves
Kent, Ohio

ALTRUISTIC CEOs?

Your warm and fuzzy description of computer CEO philanthropy in your puff piece, entitled "PC Executives Champion Causes" ("Trends," November 24, 1992), may be politically correct—but it is definitely incomplete.

What's missing is a description of the billions of dollars in tax credits and subsidies promised John Sculley's company and others under the Clinton plan. Their endorsements may well have been good business, but to categorize them as philanthropy is ludicrous. How can you be a philanthropist and be "bought" at the same time?

George J. Mortensen
Atlanta, Georgia

WAITING FOR A KILLER APP

Once again, one of the evil anti-OS/2 conspirators, Jim Seymour, is blowing smoke and clouding the issue. In his column "Inside the Anti-OS/2 Conspiracy" (December 8, 1992), Seymour tells us that if only there were a "killer app" for OS/2, he and his fellow journalists would start covering the apps—and OS/2 in general—in a more favorable light.

Why must it be a "killer app" to get the attention of the press? OS/2 is a viable, functional, and stable operating system with many native applications currently available. Why not review OS/2,

DOS, and Windows apps side by side and let the public decide for itself if it is ready to move to OS/2?

Dave Aultman
Granada Hills, California

FAX QUESTIONS LEFT UNANSWERED

Unfortunately, your reasonably comprehensive review of fax devices, "The Fax Solution" (December 8, 1992), was marred by several startling omissions that directly relate to the current state of the

*Your warm and fuzzy
description of computer
CEO philanthropy in your
puff piece, "PC Executives
Champion Causes," may be
politically correct—but it is
definitely incomplete.*

computer fax industry.

While your reviewers were correct in alerting readers to the lack of approval of the Class 2 standard by the Electronics Industry Association, there was no discussion at all of the Intel/DCA CAS standard or of the emerging FAXBios application programming interface that is endorsed by companies such as Everex, Hewlett-Packard, and WordPerfect, among others. T.611, endorsed by Intel for future product offerings, was also ignored.

The issue of fax-enabled applications is a major direction for many software companies.

Richard Shockey
St. Louis, Missouri

I was truly amazed at your review of fax modems. I can't understand why you would bother to publish an article in which one-third of the modems reviewed were not tested because the generic setup string did not work with them.

Stanley D. Hoffman
Snyder, New York

• We tested and reviewed all 12 fax modems at the same time. Unfortunately,

4 of the modems could not complete the tests, so we were unable to print any scores for them.

After the fact, we worked with the hardware and software vendors in an attempt to understand why. It was then that we discovered that with a different modem initialization string, those four modems would have been able to complete at least the fax tests.—Ed.

WE'RE NOT ALL C PROGRAMMERS!

Your review of Visual Basic for DOS ("First Looks," November 24, 1992), was a tad too cynical for those of us not endowed with enormous programming capability.

Learning to program with QuickBASIC 4.5 is probably analogous to trying to build a simple home with boards and nails: no window frames, no blueprints, no roofing trusses, no nothing.

Visual Basic for DOS's menuing options are wonderful. I think you have overestimated the number of "serious programmers" and underestimated the rest of us—the passionate amateurs who want to be serious programmers.

John De Palma
Santa Monica, California

CORRECTIONS AND AMPLIFICATIONS

In our review of Pacific Data Products' ProTracer (First Looks, December 22, 1992), we listed the phone number incorrectly. The correct number is 619-552-0880.

The story "Asynchronous Communications Servers: Dialing In at Large" (October 27, 1992), should have stated that Multi-Tech Systems' MultiModem LAN is capable of both remote-control dial-in and dial-out.

HOW TO WRITE TO PC MAGAZINE

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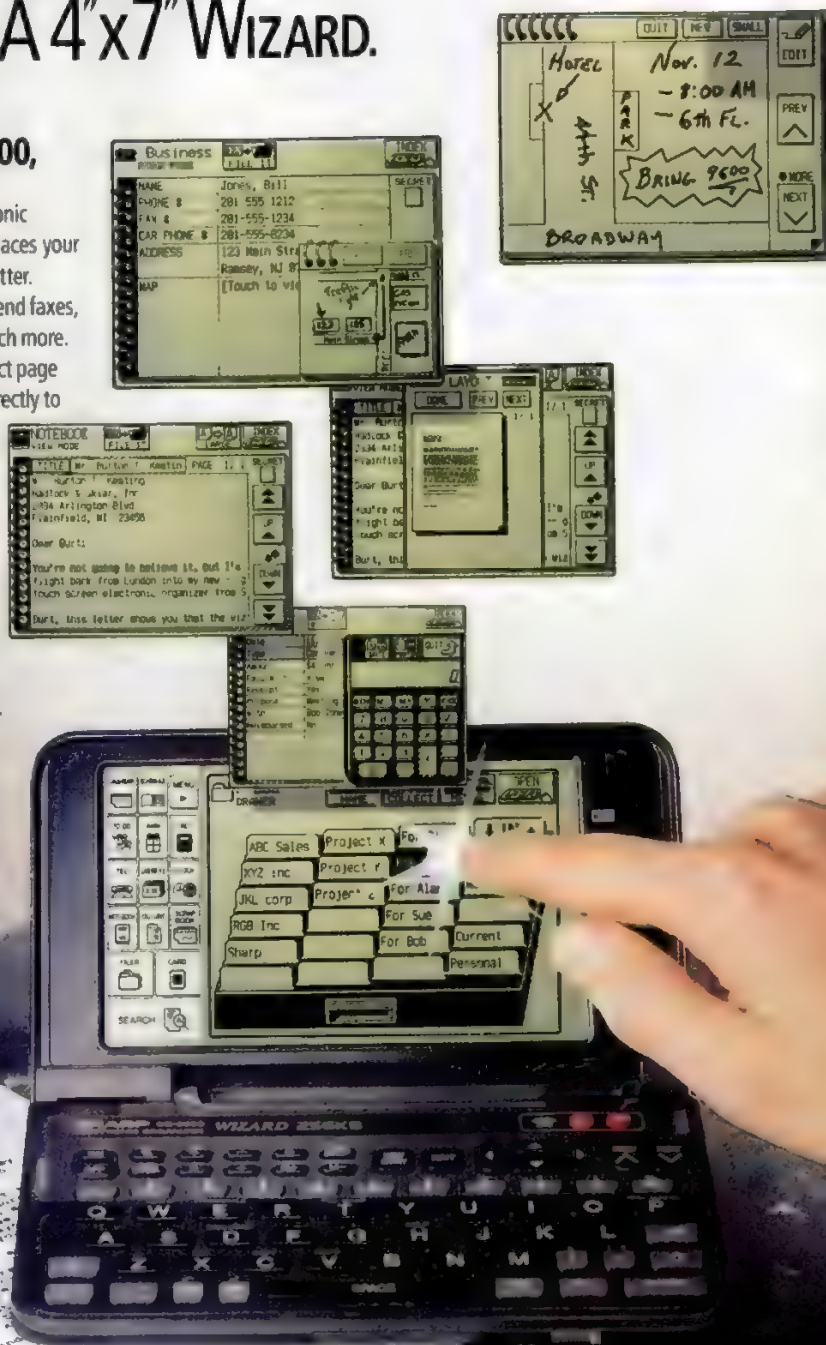
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CIRCLE 161 ON READER SERVICE CARD

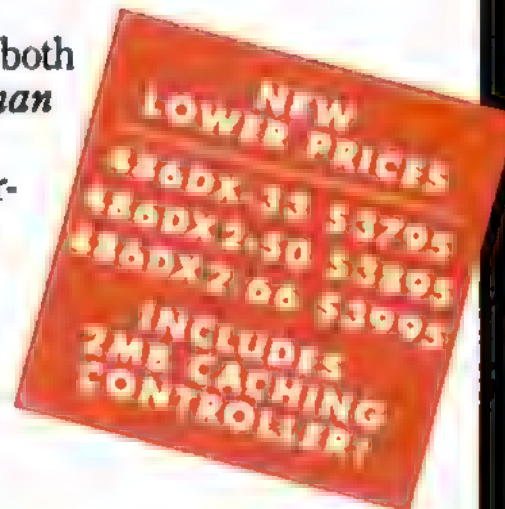


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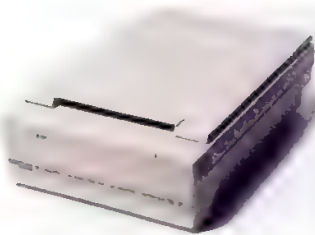
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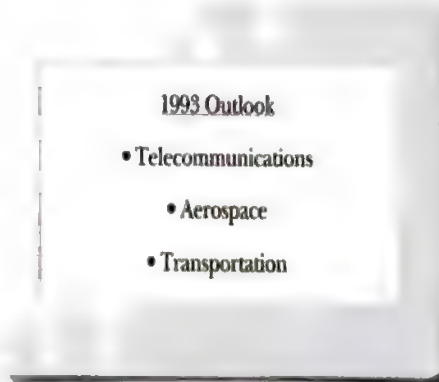


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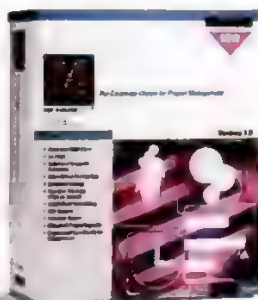
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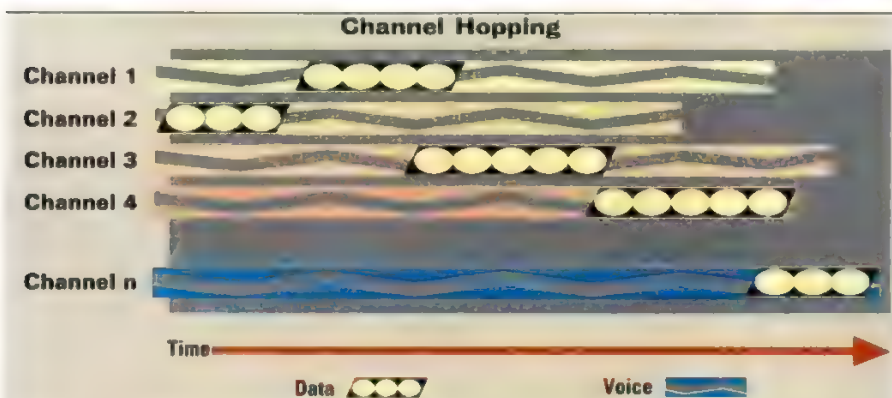
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TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

The Next Wireless Wave

CDPD gains momentum as cellular choice.

Wireless may be 1993's big buzzword—on a par with 1991's "multimedia" and 1992's "pen computing." But what does it really mean? Simply put, wireless technology is a way to connect two computers without using a physical land line between them. While there are



CDPD sends packets of digitized data over multiple cellular channels.

three basic wireless technologies—infrared, radio, and cellular—each with many subcategories and uses, a new technology called Cellular Digital Packet Data (CDPD) is garnering support and may become the dominant method for sending cellular e-mail sometime in 1994.

CDPD's many powerful proponents, which include IBM and nine major cellular carriers, contend that CDPD is preferable to other cellular technology because it lets you transmit data over today's cellular infrastructure. It's packet-switched, which means it is able to send packets of data over one or more channels (using channel hopping) instead of having to use a dedicated channel, and it's digital, so there's no problem with the interference and interruptions that plague analog transmissions. At 19.2 kilobits per second, it's faster than most of the other

cellular alternatives available.

But CDPD is only one option in a myriad of wireless choices. For networking over short distances (within an office or building, for example), infrared or spread-spectrum radio frequency (RF) provides inexpensive wireless connectivity. BICC Communications, Photonics, and Spectrix use infrared technology, which is good for making connections of up to about 60 feet. Photonics makes use of a diffuse infrared transceiver, so you don't have to point the transmitter as you would a TV remote-control unit. Proxim, Solectek, and Windata use spread-spectrum radio technology that are capable of transmitting through walls that are up to 800 feet away.

Packet radio technology, used by Ardis and RAM Mobile Data on proprietary net-

Continues on page 32

New Ideas In Docking Stations

SLIMMED-DOWN DOCKING STATIONS are becoming prevalent as an easy way to connect portable computers to modems, printers, monitors, and keyboards. The new connectors are one-stop docking stations not much larger than a power strip, and they usually weigh less than a pound.

Until recently, if you wanted a one-shot socket you had to buy an expensive—and big—docking station ranging in price from \$450 to \$1,500. ZDS was the first to break the mold with its Readydesk Port Replicator. Priced at \$109 and occasionally thrown in for free as a sales promotion, the Readydesk snaps onto the back of four Z-Note notebooks and makes available parallel, serial, PS/2 keyboard and mouse, and VGA ports, and a plug for AC power.

Since then, other vendors have gotten into the act. AST Research now makes the \$99 EasyPort port replicator in addition to its \$449 PowerStation docking station. While the PowerStation accepts 16-bit ISA cards and has two 5.25-inch drive bays in addition to the ports, the EasyPort gives you access only to the ports. Even Compaq makes a port replicator. Its \$79 Quick-Connect is made for the LTE Lite series. Apple is making port replicators, too. In its new Powerbook Duo system, Apple makes both a desk station, the \$1,079 Duo Dock, and a port replicator, the \$589 MiniDock.

—Christopher Barr

Built-in Service: A New Battleground

AS THE PC PRICE WAR STARTS TO die down, personal computer manufacturers have already found another battleground. The new front is the so-called value war: Now it's a fight to enhance products with bonus features, new technologies, and attentive service and technical support. Things really promise to heat up in the areas of service and support.

Every PC vendor has a catchphrase for its new commitment to service and support.

TEST GROUP	CONDITION
Video Subsystem	Pass
Bus Controller Registers	Pass
Memory Controller Registers	Pass
I/O Controller Registers	Pass
MMIO/RTC Registers	Pass
Programmable Interval Timer	Pass
Real-Time Clock	Pass
Interrupt Controller	Pass
Cache Card	Pass
Memory Configuration	Status
Memory Shadow	Running

Dell's latest 486 systems come with Dell Embedded Diagnostics stored in flash memory.

At CompuAdd it's "HelpLine," at IBM it's "HelpWare," and at Zenith Data Systems it's "Total Care." Some companies offer programs like Digital Equipment Corp.'s Multivendor PC Service Plan that cover systems from multiple vendors in a networked environment. All of these programs are intended to give users more toll-free access to better technical support.

The competition has already prompted Compaq and IBM to offer three-year warranties on many of their systems.

Other companies, such as Dell and ZDS, are emphasizing easy maintenance for users in their latest systems. Snap-together parts and fewer screws reduce the time and effort users have to put into expanding or upgrading their systems.

Manufacturers are even designing features into their systems that will make diagnosing system problems easier. Disk-based diagnosis has been available for several years, but when a system couldn't be booted up, end users were out of luck. Enter Dell's exciting Dell Embedded Diagnostics (DED). Currently available only in its new line of ISA-based 486 PCs, DED is stored in flash memory and detects system problems down to the component level. Even when the system won't boot up properly, DED can be run by hitting the reset button twice, and it will report any system problems on-screen.

But memory-resident diagnostics is by no means a new innovation. ZDS has been putting diagnostic programs into its systems' ROM since the early 1980s. ZDS also offers a built-in debugger for performing tasks such as disassembling software and changing video modes.

Other companies are hoping remote diagnostics will boost the value of their systems. A user calls the company's technical support staff, who then dial into the user's PC, take control of the system and run diagnostic software over the line to determine the system's problem. This cuts down on the time it takes users to describe symptoms to technical support or to figure out the rem-

edy for a diagnosed system failure.

NEC Technologies is shipping CO/Session Remote Communication Software and a data/fax modem with its Ready family of low-cost personal computers so that users can take advantage of NEC's ReadyRemote technical support. Ares Microdevelopment (800-322-3200) and ExpoTech Computers (800-284-3976) also sell systems with internal modems. Using Central Point Software's Commute for its remote diagnostics, ExpoTech is able to edit a user's CMOS remotely when a hard drive configuration is

lost. It can also transfer files such as device drivers. And ExpoTech includes an emergency disk with all its systems that is not only bootable, but also contains the Commute program.

Remote diagnostics doesn't help the PC owner whose machine won't boot up, but it provides an interesting alternative to disk-based diagnostics. And although it may only run at 2,400 bps, customers get the modem, which adds up to another plus in the value equation.

—Brad Grimes

Pipeline By Robin Raskin

Fatal Printer Error?

Irony of ironies? The Windows Printing System, Microsoft's new under-\$200 printer cartridge, is designed to take the headache out of Windows printing. But it may ultimately cause quite a few headaches for Microsoft. The product itself is not the problem. In fact, it works like a charm. The cartridge plugs into the font slot of any HP LaserJet II or III printer and speeds Windows printing anywhere from two to ten times. The cartridge acts as its own printer controller, driving the LaserJet directly and eliminating the need for any translation between Windows' GDI (Graphics Device Interface) and the printer's page description language (PCL or PostScript). Better still, the cartridge installs with its own souped-up version of the Windows Print Manager—one that handles half-toning, two-sided printing, and more.



PHOTO: BORN BY PETER GREGORIE

And the unit's bells and whistles are impressive, too. The cartridge has bidirectional communications with a local printer and uses sound for the printer and computer to talk to each other. Auditory feedback is provided when a print job is started, when a paper tray is empty, and when a jam occurs.

But good products don't always make for goodwill—especially when they're from Microsoft. The first suspicions of foul play came from Destiny Technology. According to David Larrimore, Destiny's VP of marketing and sales, Destiny shared its technology for GUI-based printing solutions, used in its WinStyler family of controllers, with Microsoft over the course of six months in 1991. Larrimore says that members of Microsoft's Windows Printing Group assured him that Microsoft would not bring a similar product to market—although he couldn't get anyone from Microsoft to put anything in writing. Larrimore is waiting to see Microsoft's final product before he decides what action he will pursue. Meanwhile, members of Microsoft's Windows Printing Group, who don't recall the meetings with Destiny, insist the Windows Printing System was developed only with Microsoft technology.

Strike two is the fact that WPS supports only TrueType fonts: It does not recognize Adobe Type 1 fonts or any other device fonts. The legions of Adobe Type Manager (ATM) users who may have gotten ATM with Ami Pro, Lotus 1-2-3, WordPerfect for Windows, or many other packages have two choices: They can change the fonts in their documents to TrueType or revert to the LaserJet driver. Still, they are bound to feel like pawns in the Microsoft/Adobe font battle.

WPS is the only system that is solely TrueType-based. The GDI in Windows 3.1 knows how to render TrueType, but it hasn't the foggiest notion about Type 1 fonts. When the GDI sees a Type 1 font it calls a device driver to recognize and raster it. Supporting ATM would involve some work, but other companies with GDI-based printing solutions, including LaserMaster (WinJet), Myriad (PrintSprint), and Destiny (WinStyler) all deal with Type 1 and other fonts. They can't afford not to.

Robin Raskin is an executive editor of PC Magazine.

Growing More High-Tech Women

TAKE ONE GLANCE AT THE BLUE-suited armies slogging through any PC trade show, and you'll see that the high-tech world is still largely a men's club. For an industry that considers itself both young and progressive, that may be hard to admit. But fortunately, there are some signs that show the times may be changing. Several companies have recently begun to focus on attracting more women to the field.

One of the highest-ranking women in the software business, CEO Carol Bartz of Autodesk, sees both the problem and a possible solution. "To attract women to the industry," she says, "it's important that women in senior positions take the responsibility of mentoring other women. Women in America are still a generation away from success, and we need to build a network."

Heidi Roizen, cofounder and CEO of T/Maker, agrees. T/Maker has become the subject of two case studies at Stanford's business school, where each year Roizen teaches two or three class sessions focused on women's issues. She urges successful women "to really get out there as role models."

High-profile role models are key. While Borland, Lotus, and Microsoft report that 10 to 15 percent of their senior managers (vice president and above) are female, Autodesk

Sierra On-Line report reaching female audiences with characters such as Carmen Sandiego and King Quest IV's Rosella. Roberta Williams, Sierra's cofounder and top game designer, says the Laura Bow Murder Mystery Series is the computer game with the highest proportion of female players (46 percent).

The companies with the most formalized efforts aimed at women and minorities are large ones such as Hewlett-Packard, IBM, Lotus, and Microsoft—all of which have full-time diversity management departments. Reminiscent of college campuses, the larger software companies have employee groups such as Blacks at HP, Women at Lotus, and Gays and Lesbians at Microsoft. These groups were organized by employees—at Microsoft, for example, software design engineer Therese Stowell founded Hoppers (named for Admiral Grace Murray Hopper) to provide a community for the company's rather isolated female programmers.

Microsoft is actively pursuing more women for technical positions. Last summer, Microsoft invited professors from three women's colleges (Smith, Mount Holyoke, and Wellesley) to attend a Women's Technical Consortium. At the end of the two-day meeting, Microsoft presented each school with a \$3,300 Women's Technical Scholarship. (Microsoft also established five new full-tuition minority scholarships last year.)

At HP, female employees have organized a Women's Technical Conference to showcase the achievements of the company's female engineers and scientists.

Last year, the conference won an award from Catalyst, a group that works with business to effect change for women. And HP's community outreach activities include working with public schools to increase the number of women and minorities in math and science.

IBM works actively with the Society of Women Engineers to recruit more women. At Lotus, June Rokoff, senior vice president of software development and the highest-ranking woman at the development house, mentors women at the director level.

Everyone agrees that the situation for women in the PC industry is getting better. "There's been a big improvement over the

Top Retail Software		
Current ranking	Last issue	Product/company
1	—	WordPerfect 5.2 for Windows WordPerfect Corp.
2	4	Quicken for Windows 2.0 Intuit
3	5	QEMM-386 6.0 Quarterdeck Office Systems
4	8	Quicken 6.0 Intuit
5	9	Microsoft Windows for Workgroups 3.1 Microsoft Corp.
6	3	WordPerfect 5.1 for Windows WordPerfect Corp.
7	11	Microsoft Access Microsoft Corp.
8	12	Microsoft Windows 3.1 Upgrade Microsoft Corp.
9	7	TurboTax ChipSoft
10	13	Office for Windows 3.0 Microsoft Corp.
11	10	Microsoft DOS 5.0 Upgrade Kit Microsoft Corp.
12	—	Microsoft Excel for Windows 4.0 Upgrade Microsoft Corp.
13	—	Word for Windows 2.0 Upgrade Microsoft Corp.
14	2	Stacker 3.0 Stac Electronics
15	—	WordPerfect 5.2 for Windows Upgrade WordPerfect Corp.

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending December 12, 1992. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

last ten years," says Karan Eriksson, who is head of the Interbase group and one of three female vice presidents at Borland International. "Venture capitalists, who used to approach me with positions like vice president of marketing, have started to ask me to consider CEO."

And the future looks even brighter. "There are strong feeder pools of younger women moving up the ladder," says Patty Stonesifer, head of Microsoft's support division and one of the company's two female vice presidents. But, she cautions, "We can't walk away from that talent. If we don't start attracting and retaining women in key roles, then the PC industry will be shortchanged in both the near- and the long-term. A full 50 percent of the top talent/worker pool in the country will have been overlooked."

—Mary Kathleen Flynn



Heidi Roizen is the CEO of T/Maker, a \$10 million software firm.

boasts 36 percent—which is even slightly higher than the proportion at the other companies' director level. And while only 10 percent of all people on-line are women, ECHO, an on-line service with several women-only conferences, has 37 percent female membership, says founder and president Stacy Horn. Even in games, female role models make a difference. Broderbund and

Computing in the Courtroom

WHILE COMMON JUST ABOUT everywhere else, computer technology is just beginning to make significant inroads into the courtroom. Several PC-based products have recently made it easier to re-enact crimes, recall testimony, or allow remote viewers to participate in court proceedings.

Autodesk's Animator has recently gotten a lot of attention for the dramatic effect it has had on two criminal cases. On February 27, 1991, Jim Mitchell shot and killed his brother. On January 28, 1992, a jury in Marin County, California, saw a reenactment of the incident designed using Autodesk Animator. It marked the first time computer animation was used in a criminal case of that magnitude. The district attorney on the case chose a computer reenactment because a movie with actors would have been more suggestive to the jury and less fair to the defendant. Later that year, another California jury saw a case of dueling cartoons when both the prosecution and the defense used Animator to produce simulations of the same murder.

Several new products have been designed specifically for the courtroom environment. Stenograph Legal Services hopes that its DiscoveryVideoZX will become the successor to the familiar stenographer's machine. The DiscoveryVideo system combines—and more importantly, *synchronizes*—text, video, and audio images on a single screen. Attorneys, judges, and court reporters can enter a search term (for instance, "picked up the gun"), and DiscoveryVideo will locate that portion of text from the court proceedings, prompt the user



Autodesk's Animator simulates the crime.

DELL COMPUTER MORE THAN DOUBLED

its revenue last year, making the mail-order manufacturer the No. 5 personal computer maker in the world (up from No. 11 in 1991), according to Dataquest's preliminary 1992 worldwide PC market share survey results. No. 2 Apple Computer and No. 3 Compaq also did well, with Apple growing more than 14 percent and Compaq growing nearly 19 percent. IBM only barely hung on to its No. 1 spot, and the company's PC revenue shrank by nearly 19 percent. NEC lost both market share and position, dropping from No. 3 in 1991 to No. 4 last year. Overall, the worldwide PC market grew from \$43.4 billion in 1991 to \$46.5 billion in 1992, according to the San Jose-based research firm.

HIGH-TECH WOMEN GAINED A POWERFUL

role model when the world's largest technical professional society, the

to insert the correct videotape, and then display a screen with an image of the speaker and the words both spoken aloud and visible on the screen. The system, which uses a standard MS-DOS PC and either NEC's \$2,100 PC-VCR (First Looks, July 1991) or a Sony 8mm VCR, costs \$4,800 (800-443-8007). A Windows version is planned for early 1993.

Court Technologies has developed Visual Due Process (VDP), a system of integrated audio, video, and computer technology that allows viewers at other locations to participate in court proceedings. VDP uses up to six voice-activated video recorders connected to three computer-controlled VCRs. Participants watching a split-screen monitor can see and hear the entire event without being in the same room. The system can not only protect sensitive witnesses, but it can also save money by eliminating the need to transport people to and from arraignments and hearings.

—Andrew Kantor

Briefs

Institute of Electrical and Electronics Engineers, named Martha Sloan as its first woman president. The only woman in her 1961 graduating class in engineering at Stanford University and the first female professor of electrical engineering at Michigan Technological University (where she still teaches), Sloan hopes her presidency will encourage more young women to enter the field. The IEEE reports that the number of women engineers has already grown over the last decade from 5.7 percent to 8.2 percent.

PC NETWORK SERVICES AND BUSINESS

phone services are linking up as Novell and AT&T join forces. By the end of the year, Telephony Services applications are expected to let NetWare users take advantage of common phone features—auto-dialing, conference calling, and message management—in combination with data on the network.

—Mary Kathleen Flynn

Wireless Wave

CONTINUED FROM PAGE 29

works, provides wide-area coverage for short data-only transmissions. Because of the expense, packet radio is not designed for the constant connection that a traditional network provides, and most wide-area networks still require land lines to connect disparate locations. CDPD's advantage over packet radio is that at 19.2 Kbps, CDPD is faster than packet radio's current 9.6 Kbps data rate. And CDPD can handle voice as well as data.

Many other wireless technologies are now on the drawing board or are undergoing testing. Most notable among these possible systems are Motorola's multibillion-dollar Iridium project, and Cellular Data's CDI. Using 66 low-earth-orbit satellites (LEOS), Iridium will blanket the globe with a wireless network. But Iridium is not expected to be operational until the end of the century. CDI, a cellular technology that will compete with CDPD, is currently being tested and is not expected to be rolled out until the end of 1993.

In the meantime, Apple, EO, and IBM are investigating CDPD and its considerable capabilities as a way to breathe life into their personal digital assistants and personal communicators.—Christopher Barr

OS/2

A GREAT PLACE TO WORK

**THE OS/2 WORKPLACE SHELL LETS YOU WORK
THE WAY YOU WANT TO.**

With objects, folders, templates and drag-and-drop actions, the OS/2 Workplace Shell offers a friendly, intuitive applications environment that's truly object-oriented. It's fun, straightforward, easy to use and works in the same way you do. There's none of the confusing techno-speak that comes with other operating systems. In short, there is almost no learning required and the environment can be as simple or sophisticated as you want.

1 THE WORKPLACE SHELL PROVIDES A STRONG FOUNDATION FOR YOUR APPLICATIONS
After installing OS/2, the Workplace Shell appears with a predetermined selection of tools and folders that will help to familiarize the OS/2 novice with the system's capabilities. For instance, the Drives object offers a fast path to file manipulation, and the Productivity Folder contains a selection of information management and time management tools.

But these are only the beginning. OS/2 has no menu bar, so you have a wide-open space on which to install the objects that you create and applications that you need. And the ability to place folders within folders—on a virtually infinite basis—lets you sort and arrange objects exactly the way you want to. As a result, the Workplace Shell has the ability to be as comprehensive or as simple as the situation requires.

OS/2 menus also provide a coherent context, offering only the commands that are available from that point in the interface. This gives you a clear idea of the various choices available in each situation, and doesn't bog you down with irrelevant commands.

2 OS/2'S OBJECTS ECHO COMMON DESKTOP METAPHORS

Under OS/2, a Desktop object falls into one of four categories:

File. OS/2 further develops the traditional file-as-data-receptacle metaphor.



Files hold data and are tied to applications. So a "Memo" created in DeScribe sits on

Config.sys the Desktop, where clicking on the icon loads the file and the application in one step.

Program. This includes standard application programs, utilities and tools. A program object, independent of a file, is positioned on the



Desktop for easy access **Window Washer** and in many cases controls system functions.

Device. A device qualifies as any peripheral that connects OS/2 with the outside world: printer,



FAX, modem, network or disk drive all appear as Desk-

Shredder top objects. The Shredder—essentially the OS/2 delete command—is also represented in the same way.

Activating a device object is simple and straightforward: You highlight the file and drag it over to the device to execute the command. Where appropriate, a dialog box appears to confirm the command.

Folder. The OS/2 folder acts like its analog counterpart, containing several different parts that all relate to the same subject. It may contain a combination of files, programs and devices, all pertaining to a single task or project. You can also install a folder within a folder (or an object within a folder) to build a hierarchical series of objects.



Games

4 OS/2 TEMPLATES SET THE STAGE FOR CUSTOMIZED DATA ENTRY

The OS/2 Templates folder, installed with the Workplace Shell, allows you to instantly create objects on the Desktop. Any item in the OS/2 Templates folder can be highlighted, dragged to another location, and opened as a custom file, where it becomes the appropriate database, spreadsheet or document for data entry.

In addition, many OS/2 applications place a custom template into this folder during installation. For instance, to create a memo you may highlight the DeScribe Template and drag it to the Desktop or into a new folder. Then, Alt-single click on the title and modify it accordingly. It's much like a pad of paper, where you tear off one sheet at a time. Under OS/2, each sheet of "paper" harnesses all the full power of the operating system. So instead of a pad of paper you can have a pad of spreadsheets.

5 OS/2 HAS STYLE

It's easy to personalize OS/2's interface to reflect your own taste and style. The primary tools to do so—tools controlling color and fonts—are in the System Setup folder within the OS/2 System group... just four mouse clicks away from the Workplace Shell's opening screen. Here you give each window, folder and object its own color and font scheme and bring a new level of personality to the Desktop.

With the Color Palette, you select the desired hue with a single right-button click, at which point the cursor changes into a paint roller dripping with that shade. You drag the cursor to the destination—a window, menu or Desktop—and release. The color changes instantly. Similarly, to modify

6 THE WORKPLACE SHELL IS A GREAT ORGANIZER

The Workplace Shell is more than a digital desktop from which you launch computer applications. The most significant difference between Workplace Shell, the touchstone of OS/2, and the controlling interfaces of other operating systems, is that it is completely customized to fit individual needs. There are no fixed objects in the Workplace Shell. You can easily add or delete any system or program function and include as many or as few commands on the Desktop as you wish. Some people like their desk messy, others like their desk clean.

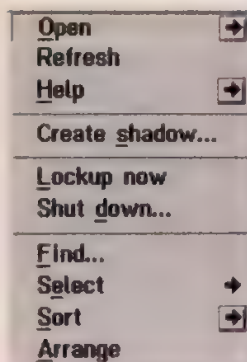
Furthermore, almost all aspects—fonts, colors and icon arrangement—are easily user-modified, with minimal reference to documentation. In most cases, modifications to the OS/2 environment only require a simple drag-and-drop command.

More significantly, the Workplace Shell is completely object oriented—each Desktop object offering a direct path to a file, program, device or folder. This brings a real-world metaphor to the computer Desktop, as everything within OS/2 has a frame of reference to the "real world."

And like your own desk, access to the contents of the object is immediate. You don't need to issue commands to load a program or open a file in order to access the object's contents. This imitates the way you work. You don't need, for instance, to click "Alt-File-Open-Budget" to open a paper folder with a spreadsheet inside.

3 POP-UP MENUS GIVE USERS CLEAR CHOICES

Pop-up menus show exactly what you can do at any given time. Clicking the right mouse button anywhere on the Desktop opens a pop-up menu, which controls the most important Workplace Shell functions. Besides the ability to arrange and sort all Desktop objects, this menu controls password lockup and shutdown. Like other OS/2 menus, this feature shows only the choices that are available from that point in the interface.



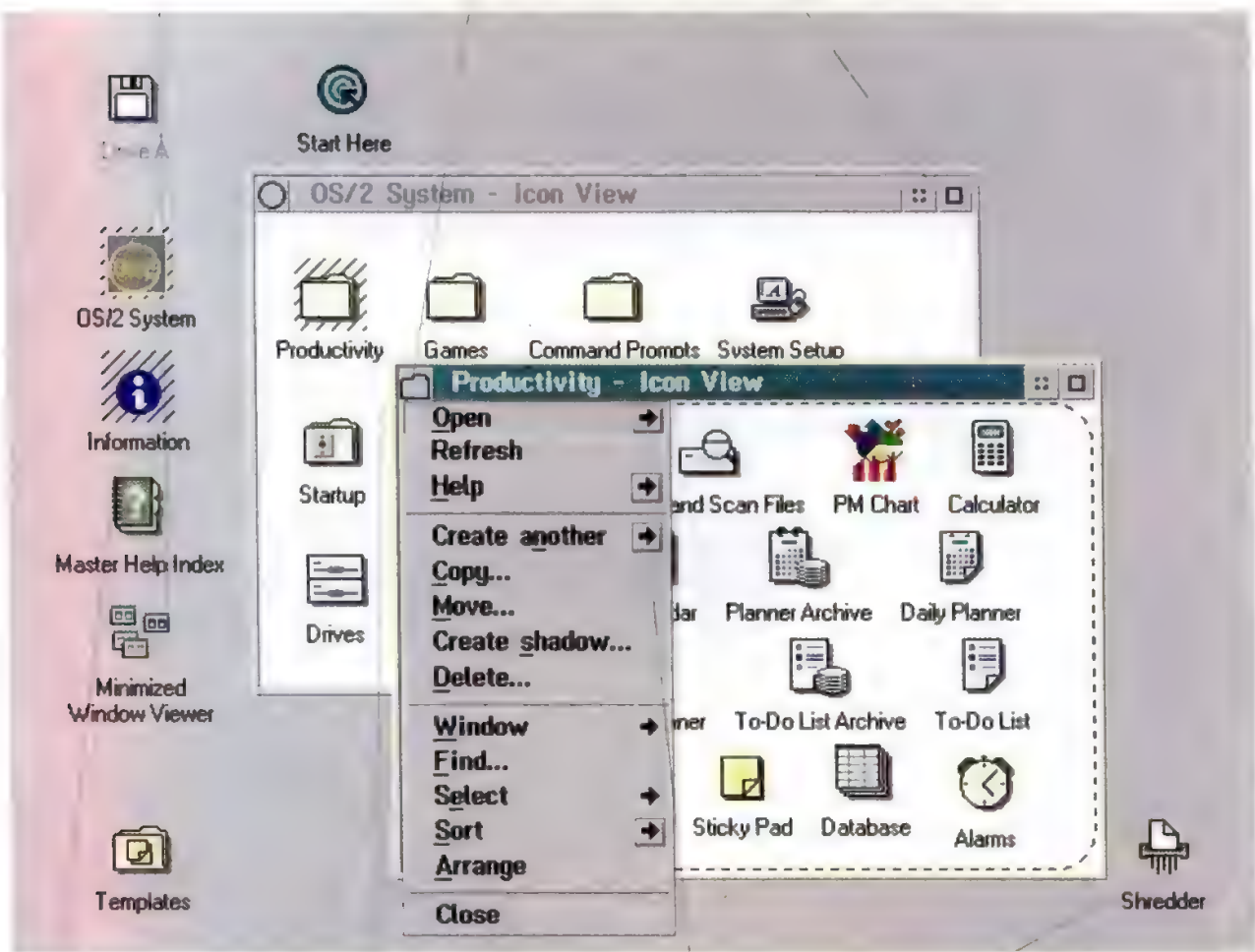
the font on any menu or window, you highlight a type style on the Font Palette and drag it to the target.

The Scheme Palette allows you to customize colors and fonts for individual windows, or across the system, in one action. The Color Palette and Font Palette actions only affect the target windows, or you can hold the Alt key to make the modification work universally.

The Minimized Window Viewer offers an icon view of all open applications. You can also get a task list with a simultaneous left/right mouse click anywhere on the Desktop.

The upper left-hand corner of every window contains the program icon for the active application. This gives each OS/2 window an individual nature and offers an immediate visual clue about the window.

Hide, Minimize and Maximize commands are part of every OS/2 window. A single click on the small square hides the application but keeps it active. A single click on the large rectangle switches between full screen and window size.



The shading on a Workplace Shell object indicates that the application is currently active. A double-click motion accesses the open copy of the object directly.

OS/2 allows objects and folders to nest within other folders. As you progress from one folder to another, each is automatically cascaded on the Workplace Shell surface.

OS/2 menus provide all the choices available for a particular object, along with the context. Here, the menu commands control the area within the dotted line.

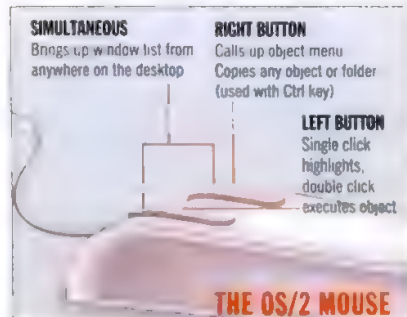
When a device object is represented anywhere on the Desktop, you can drag-and-drop another object to execute a function. Dragging a file over the shredder object would delete that file.

THE OS/2 MOUSE IS AN ARTFUL DRAG-AND-DROP TOOL

OS/2 relies on the right mouse button to complete drag-and-drop commands, allowing you to control objects in an intuitive way. You highlight a file or an object with a single right-button click, hold the button down and pull it to the desired location—inside another folder, to a device, or onto the Desktop. Releasing the button executes the function.

Drag-and-drop isn't restricted to a single item. If you highlight a file or object with the left mouse button and drag it across another file or object, this highlights both items and allows you to execute a single function like print or shred.

Mouse/key combinations also help to execute the drag-and-drop functions. Ctrl-right mouse button makes a copy of any file or object, which can be moved to any folder.





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CIRCLE 024 ON READER SERVICE CARD

First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

■ PCs

Dell's Creative New 486 Designs Stand Out

BY TIN ALBANO

As prices begin to level off, PC vendors are looking for new ways to compete. Dell Computer Corp., one of the most competitive of the direct-channel vendors, is focusing its attention on enhancing overall system performance while continuing to maintain its price points. By revamping all of its 486-based desktop PCs, Dell is staying in the thick of the fight.

Dell's new 486 lineup includes four different families. The 486/L line has five ISA-based slimline models. The five midsize 486/M units and the three tower units that make up the 486/T family are also ISA-based. The five 486/ME models are midsize EISA-based units, and the first PCs we've seen that

will be upgradable to be compatible with some form of Intel's Pentium microprocessor technology when it becomes available.

As a response to the growing need for faster graphics performance, Dell has equipped the new systems with integrated local-bus video. Also added are

486/ME: Dell's fastest EISA-based computer yet.



buffered serial ports, widely used by other manufacturers but missing from previous Dell PCs. Buffered serial ports guard against data loss during communications operations by providing a memory buffer, where in-

formation can be stored until it's ready to be processed by the CPU. The end result is a family of PCs that proves to be very competitive with other 486-based PCs.

■ PROBLEM SOLVER

One sensible new feature, embedded system diagnostics, is found only in the ISA-based units. Unlike common disk-based diagnostic programs, which are useless when a computer can't boot its operating system, Dell's diagnostic programs are stored in flash memory and are capable of detecting system failures even when the problem prevents the

• Continues on page 38

■ Multifunction Devices

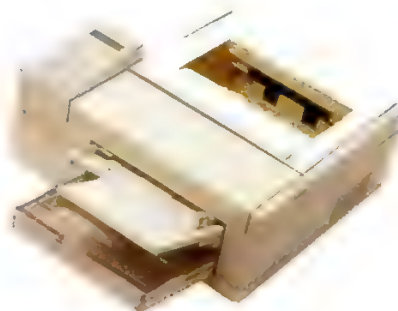
Print, Fax, Copy, and Scan with Okidata's All-In-One DOC•IT

BY BRUCE BROWN

When multifunction document processing devices were first discussed, they were seen as the key to the paperless office. Of course, we all know offices will never be paperless, but even if we can't save paper, we can save desk space. By combining four document-processing devices into one, Okidata's \$4,999 DOC•IT 4000 is a peripheral with convenience written all over it.

The DOC•IT unites the functions of a standalone laser printer, a plain-paper fax machine, a midlevel personal copier, and a scanner with an automatic document feeder and a removable head for hand-held scanning. Included Microsoft Windows-based document-

processing software helps when using the device's multiple functions either individually or in unison to create or disseminate documents.



FOUR IN ONE: The \$4,999 Okidata DOC•IT 4000 is very compact.

While it's not the first device to offer more than one function (many fax machines and some page printers can do some copying), the DOC•IT is the first of the so-called "hydra" devices to

combine printing, copying, faxing, and scanning. Installing and configuring the DOC•IT is a bit tricky and at first glance the price seems high, but the DOC•IT's individual functions are of as good a quality or better than those provided by most standalone products.

TWO MODELS

Okidata sells two DOC•IT models. The HP LaserJet IIP-compatible DOC•IT 3000 lists for \$3,999, while the more powerful HP LaserJet III- and PostScript-compatible DOC•IT 4000, which we tested, retails for \$4,999. With actual selling prices closer to \$3,000 for the DOC•IT 3000 and \$3,500 for the DOC•IT 4000, the more powerful 4000 model is clearly the

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First Looks

Dell

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system from booting.

Dell's diagnostic programs are keen enough to spot problems down to the component level. For example, a faulty single in-line memory module (SIMM) would handcuff any computer, causing a nonbooting system error. Since Dell's diagnostics reside in flash memory, simply pressing the reset button twice activates a program that can quickly spot the defective SIMM. (See Trends in this issue on Dell's embedded diagnostics concept.)

SNAPPY ARCHITECTURE

The ISA-based 486/L systems are the most compelling of all the new Dell models. In addition to the integrated local-bus video and embedded system diagnostics, the 486/Ls implement a "snap-together" design that allows the computer's most frequently serviced components—the disk drives and motherboard—to snap in and out of place with flexible quick-release devices.

Another structural change that is found only on the 486/L machines is the Expansion Card Cage, a patent-pending Dell invention. By removing just one screw, you can lift the cage out with the expansion cards and cables still attached.

Replacing the clumsy horizontal-expansion design of most slimline models, the cage, which holds three full-length 16-bit boards, is a great innovation that saves you from having to pull expansion cards out when you need to get to the guts of your machine.

COMMITMENT TO PERFORMANCE

We evaluated two 66-MHz 486DX2 systems: the \$3,319 466/

L and the \$3,869 466/ME. Each unit came with 8MB of RAM (expandable to 64MB), a 230MB IDE hard disk, 512K of video RAM (a 1MB video upgrade is also available), and a 128K cache card.

Both the 466/L and the 466/ME performed well on PC Magazine Labs' benchmark tests. Compared with the 74 66-MHz machines that PC Labs tested for "66 MHz: The New Speed Limit" (January 26, 1993), the Dell systems turned in scores well above the average on our entire benchmark suite, with the exception of their performance on our disk test routines. And although the 466/L and the 466/ME disk scores seem mediocre when compared with the average scores of other

subsystems that increase both the speed and the price of a PC.

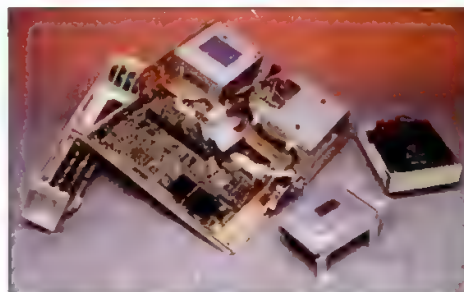
VIDEO IMPROVEMENTS

Since the chronic craving for faster video performance has been temporarily satiated by

Graphics Winmark score of the \$5,192 Compaq Deskpro 66/M, with its EISA-based QVision. Their scores were topped only by a handful of 66-MHz 486DX2 PCs equipped with

ATI's VESA VL-Bus ATI Graphics Ultra Plus and by the amazing 42.64 Graphics Winmark score turned in by the \$2,995 Zeos 486DX2-66 (using Weitek Corp.'s Power 9000 chip set).

Both of the Dell systems that we tested are very competitive at the



INSIDE: The 466/L's internal components snap apart for easy access.

VESA VL-bus cards, computer manufacturers wishing to be competitive in today's high-end desktop computing market must provide for local-bus video.

The most significant performance enhancement that the new Dell 486s have over their predecessors is the implementation of an integrated local-bus video subsystem. Dell's earlier 486-based ISA and EISA models used ISA-based video accelerators (the Western Digital WD90C31 and the ATI Graphics Ultra Pro, respectively). The new systems use S3's local bus-based 86C805 video controller, a controller that achieves outstanding results and leaves much of its competition far behind.

The 466/L's Graphics Winmark score of 13.57 megapixels per second and the 466/ME's score of 15.51 outpace the 12.34

high end of today's desktop market, and the unique architecture of the 466/L and the rest of the 486/L family make it stand out among the other slimline desktop models that are currently available. Dell's approach has paid off.

•List price: Dell 466/ME including 8MB RAM, 230MB hard disk, 512K video upgrade, 128K cache card, dual-media floppy drive, DOS 5.0, Microsoft Windows 3.1, mouse, 15-inch SVGA monitor, \$3,869. List price: Dell 466/L including 8MB RAM, 230MB hard disk, 512K video upgrade, 128K cache card, dual-media floppy drive, DOS 5.0, Microsoft Windows 3.1, mouse, 15-inch SVGA monitor, \$3,319. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; 800-289-3355, 512-338-4400; fax: 512-343-3653.

Circle 422 on reader service card



466/L: A super performer with an innovative expansion design.

66-MHz 486DX2s tested by PC Labs, they're actually quite good when contrasted with other systems not outfitted with large SCSI hard disk

Benchmark Tests: Dell 486 Series

We tested 2 of Dell Computer Corp.'s 18 recently-introduced 486-based PCs: the 66-MHz 486DX2-based 466/L and 466/ME. The machines' implementation of an integrated local-bus video subsystem yielded outstanding scores on both our DOS Video and Graphics Winmark tests.

We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.0, to measure each PC's processor, memory, video, and disk subsystem performance. The Graphics Winmark score is based on 12 Microsoft Windows graphics and text functions, weighted to reflect how frequently the various functions are used.

Higher scores represent better performance.	Processor (operations per second)	Memory (kilobytes per second)	Video (thousands of operations per second)	Disk (kilobytes per second)	Graphics Winmark (megapixels per second)
Dell 466/L (ISA-based 66-MHz 486DX2)	17,532.53	9,969.78	7,010.82	34.84	13.57
Dell 466/ME (EISA-based 66-MHz 486DX2)	16,349.01	10,182.44	6,751.58	35.53	15.51
66-MHz 486DX2 average	15,354.59	6,304.61	3,784.34	47.66	8.09

First Looks

Okidata

CONTINUED FROM PAGE 37

smarter choice for you to make.

The unit is about the size of an average desktop laser printer, 8.5 by 17.8 by 16.9 inches (HWD), and weighs 36 pounds. The included expansion card that you add to your PC holds DOC•IT's image memory (7MB is standard for the 4000) and has a 32-bit Intel i960 RISC processor, proprietary ASIC chips, a fax module, and a video bus.

PRINTING

The printer component uses an 8-page-per-minute LED printing system with a 16,000-page monthly duty cycle. The printer's consumables, a 2,500-page toner cartridge and a 15,000-page image drum, are identical to those used in Okidata's OL800 page printers, so the availability of replacements isn't a problem.

The DOC•IT 4000 has a maximum printing resolution of 400 dpi, and it comes with 13 TrueImage PostScript-compatible

typical printing with a U-shaped paper path, the printer can hold up to 200 sheets of output. Straight-through paper path printing is also possible; the rear-mounted output tray holds 100 sheets face up.

FAXING

For faxing and copying, the DOC•IT uses a front-mounted, 25-sheet automatic document feeder and document-scanning device. You manage copying and faxing with DOC•IT's control panel and can do either while the attached computer is turned off or busy with other applications. You can also send faxes directly from computer files using included Windows and DOS software.

The Group 3 plain-paper fax component sends and receives faxes up to 9,600 bits per second. Standard 200- by 100-dot-per-inch and fine 200- by 200-dpi modes are both supported for faxing to other devices; you can also fax at 400- by 400-dpi to other DOC•IT 4000 users or at 300- by 300-dpi to DOC•IT 3000 users.

Okidata DOC•IT 4000
*Okidata, 532 Fellowship Rd.,
Mount Laurel, NJ 08054, 800-
654-3282, 609-235-2600*

List price: \$4,999
Requires: 2MB RAM (4MB recommended), 7MB hard disk space, Microsoft Windows 3.0 or later
In short: Okidata's DOC•IT is a convenient, space-saving document processing peripheral that combines better than average laser printing, plain paper faxing, copying, and scanning in one device. But even with hefty discounts, DOC•IT's price may be hard to justify for a single user.

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features include text, photo, or mixed-image modes, and 2-up and merge copy modes.

The 2-up copy mode lets you feed two full-sized sheets, hold them in memory, and then print them reduced, side-by-side, in landscape orientation. The merge copy mode lets you feed two sheets and have the contents combined on a single copy output sheet, a useful feature for combining text with borders or letterhead.

SCANNING

The built-in 8.5-inch-wide scanner head is HP ScanJet Plus-compatible and can scan up to ten pages per minute when used with the automatic document feeder. For originals that you can't or don't want to send through the feeder, you can remove the scanning head easily (it has a permanent coiled cord) and use it as a hand scanner to scan book or magazine pages or other originals. Scanning can be done at bilevel mode for text or line drawings, or in 16 or 64 gray-scale modes.

The Windows-based DOC•IT Manager provides a common interface for DOC•IT functions and also includes an image editor that can be used with received faxes and scanned documents. DOC•IT Manager lets you combine tasks for efficient document processing. For ex-

ample, you could import text from a stored word processing file, scan and add graphic elements such as logos or photographs to the document, and then transmit the finished document to one or a group of fax recipients.

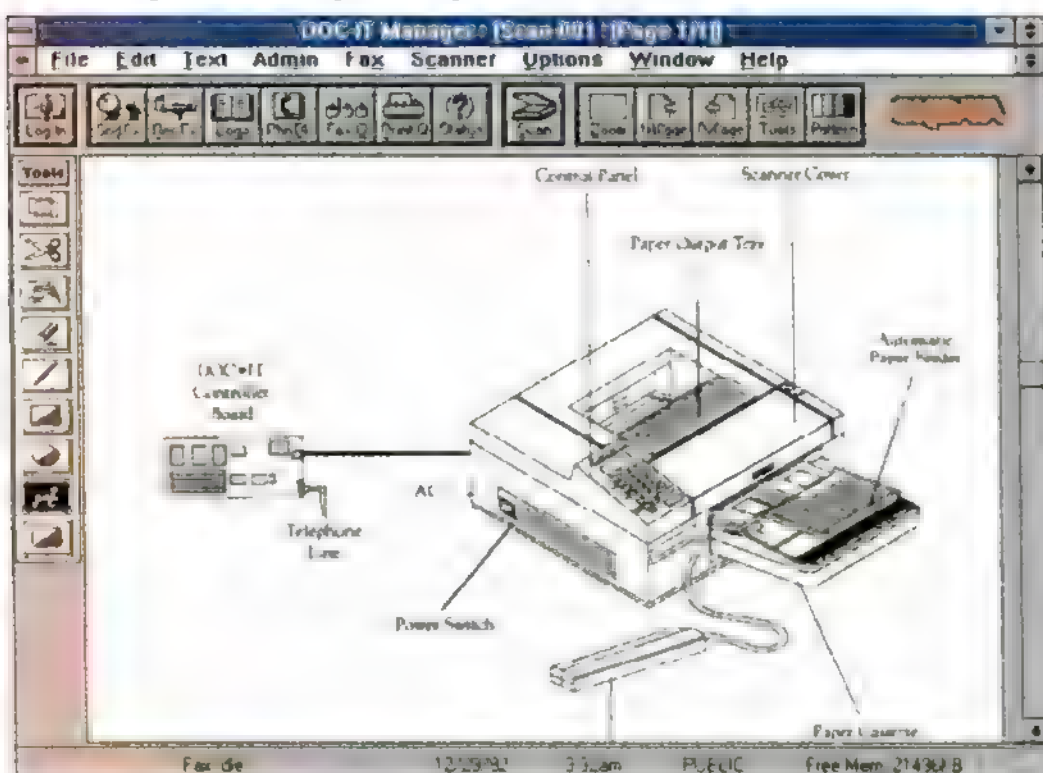
TRICKY SETUP

Physically installing the DOC•IT board and software is simple, but getting all of the components to work properly is complicated by proper port assignments, IRQ settings, and system memory conflicts. Improved installation software that could detect conflicts and suggest or implement corrections would be a big help.

Distribution for the DOC•IT is currently limited to ComputerLand retail stores and selected value-added resellers, and the unit's relatively high price and current finicky installation warrant the sales and support assistance that you'll get through those channels. The unit comes with a one year warranty on the full machine and five years on the LED print head.

The DOC•IT best serves someone who regularly needs a printer, scanner, copier, and fax machine, or at least three out of four, as long as one of the three is a printer. A small group of people can effectively share the DOC•IT as well, but the unit is not networkable. Don't make the mistake of assuming that you can justify the cost of the system by spreading it among 20 users. That's not what the DOC•IT is designed for.

The multifunctionality of Okidata's DOC•IT 4000 hints at the direction in which new page printers will develop. Space-saving peripherals with increased document-handling convenience and efficiency have an obvious advantage over separate devices. Current price levels exclude many mainstream buyers, but as more models appear and prices begin to fall, the DOC•IT 4000 and its competitors will start to show up on uncrowded desks everywhere. □



CONTROL CENTER: Windows-based software manages all four of the DOC•IT's functions

tible resident scalable fonts as well as 8 resident scalable and 14 resident bitmap HP PCL 5-compatible fonts. A TrueImage Fonts Plus option with 22 additional PostScript-compatible fonts costs \$99.

The standard paper cassette holds 200 sheets of paper. For

COPYING

The system's copying facilities surpass those found in most personal copy machines except for DOC•IT's lack of typical reduction or enlargement zooming. You can automatically feed up to 25 originals and get up to 99 copies each. Other attractive

Windows Utilities

The UnInstaller Cleans Up After Messy Windows Applications

BY EDWARD MENDELSON

When you want to get rid of a Microsoft Windows application and all of its scattered .INI files, icons, dynamic link libraries (DLLs), and miscellaneous directories, the most thorough clean-up squad you can find is built into MicroHelp's \$79 The UnInstaller.

This utility deletes Windows programs safely and efficiently and then scours WIN.INI and other files to remove all traces of the deleted program. But it's smart enough not to eliminate any files associated with the deleted program that other programs might need.

When you first run The UnInstaller, it optionally builds a database of links between applications and their initialization files and DLLs. When you select an application for the program to uninstall, it displays an elaborate list of options, including the names of files connected with the unwanted application. Files that can be safely removed are already selected, but files that probably should remain on your disk are flagged.

The program also displays a list of lines and sections in WIN.INI and SYSTEM.INI that are associated with the application you want to remove and offers to remove them. It can also remove *en masse* the discarded application's directories and associated document files. Unless you choose otherwise, it prompts you with a full explanation before every deletion.

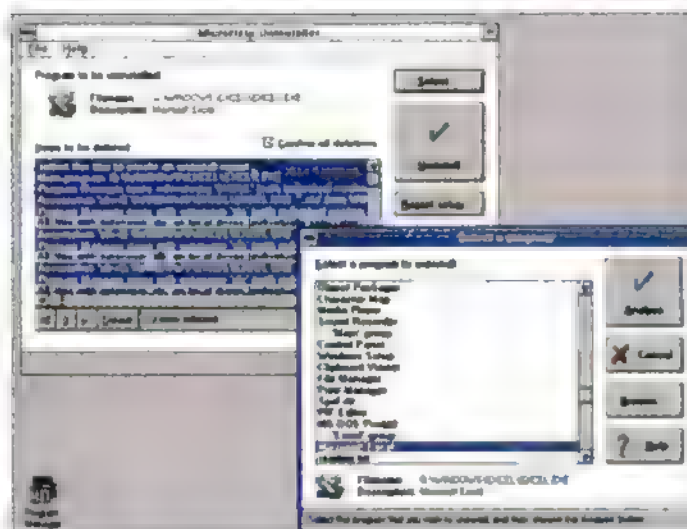
One ingenious feature of the package is its handling of network installations. When the administrator runs the program to remove an application, it installs a copy of itself in place of the application. When users on the network try to run the application, The UnInstaller appears and offers to clean up traces of

the program on their individual workstations.

One thing the program doesn't offer is speed, and its graphic-progress indicator sometimes seems to slow to a halt, even when removing the simplest application.

The UnInstaller can't remove all traces of every application. The manual acknowledges

that the program can find neither DLLs listed only in an .INI file nor removable sections in



CLEANUP: The UnInstaller makes it easy.

E-Mail Software

NvMail: Easy, Capable Network Mail—With a Catch

BY STAN MIASTKOWSKI

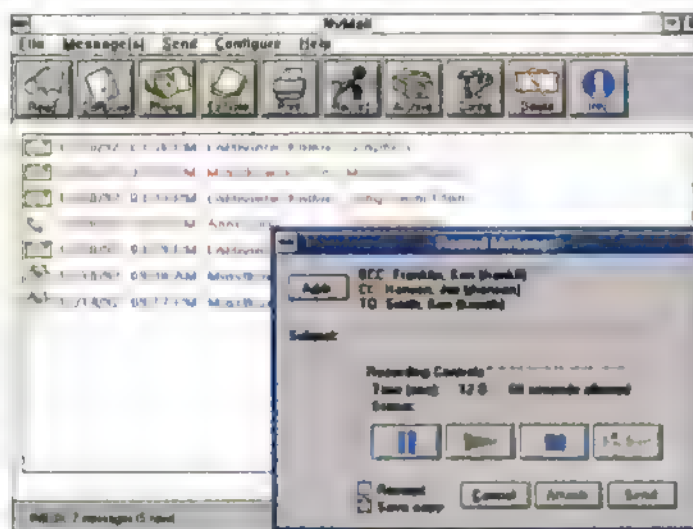
Image Machines Corp.'s NvMail is one of the easiest and most clever network electronic-mail packages available. It is also one of the least expensive, ranging in price from \$295 for a ten-user package to \$995 for an unlimited license. It works on any Microsoft Windows-compatible network, but its almost complete lack of security features seriously limits its usefulness in many installations.

NvMail doesn't get hung up on the nitty-gritty internal details of various networks. Any network that has a common drive that is accessible to all users can run NvMail. All messages and the control files are stored on this shared drive.

As the system administrator, you can install and control the NvMail system from any workstation on the network. Individual users can install their own software as long as they have been assigned a user ID.

Installing and administering NvMail is a snap, requiring only a few minutes, but no password is required to enter NvAdmin, and you can't assign passwords to individual users.

NvMail's performance is impressive, and it has a simple interface that you can figure out in seconds. Icons say what they do, and the same ease of use holds



EASY MAIL: You can send voice messages to PCs that aren't equipped with sound cards.

true as you venture deeper into the program.

Along with all the features you'd expect in a capable mail program, NvMail has a few surprises. It particularly shines in

terms of sound. Used with a package such as Microsoft Windows Sound System or Creative Labs' Sound Blaster, it sends voice messages as easily as notes: Just click on the "Record" icon, speak, and send.

Nothing guarantees perfect Windows cleaning, but The UnInstaller's tools scrub more effectively than anything else.

• List price: *The UnInstaller*, \$79. Requires: 2MB RAM, 1MB hard disk space, Microsoft Windows 3.0 or later. MicroHelp Inc., 4359 Shallowford Industrial Pkwy., Marietta, GA 30066; 800-922-3383, 404-516-0899; fax, 404-516-1099.

Circle 418 on reader service card

NvMail also has a capable phone-message facility that lets you send a quick "While You Were Out" message to others. There's also a quirky Ez-Note feature that is essentially a miniature drawing program.

A logical choice for networks that come with limited or no mail facilities, NvMail would be redundant for a network such as Windows for Workgroups, which already includes a more capable mail facility. If you don't mind the package's lack of administrator- or user-level security (beyond your network's own basic security), NvMail is a good value.

• List price: *NvMail*, \$295 for 10 users, \$495 for 25 users, \$995 for 100+ users. Requires: 2MB RAM, Microsoft Windows 3.0 or

later, any Windows-compatible network. Image Machines Corp., 590 Herndon Pkwy., Herndon, VA 22070; 703-709-7475; fax: 703-709-8966.

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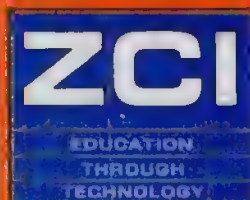
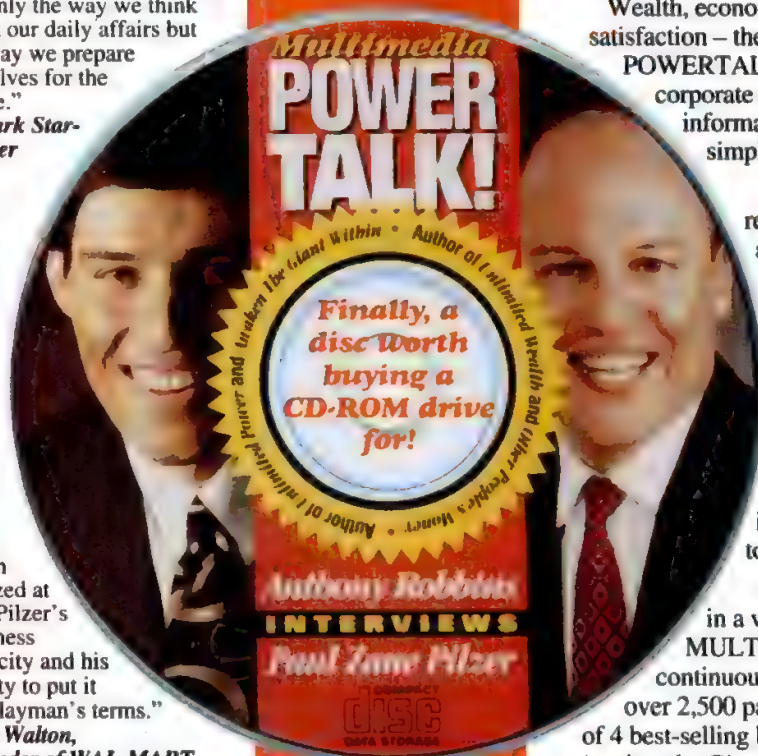
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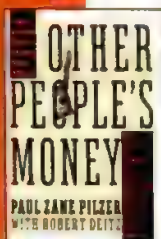
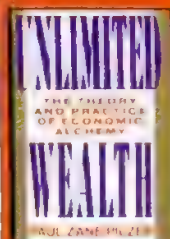
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■ OS/2 Utilities

Norton Commander: Better OS/2 File Management

BY JOE SALEMI

Symantec Corp. has delivered on its promise to support OS/2 2.0 by releasing The Norton Commander for OS/2, a \$149 utility that brings additional file management capabilities to the OS/2 Workplace Shell desktop. Both FAT and HPFS (High-Performance File System) drives are supported. It also provides OS/2 users with a simplified application menu and an easy way to execute DOS or OS/2 commands from the Workplace Shell.

ENHANCED FILE MANAGEMENT

OS/2 2.0 has a number of built-in file-management capabilities through its Drives icons, but you're limited in what you can do with them. The Drives interface is also cumbersome, requiring you to pick a drive, wait while the software builds the directory tree, then click on the directory and wait while the software builds a tree of all the files in the directory.

The Norton Commander for OS/2 brings the DOS version's file- and directory-management capabilities to OS/2 2.0 users by displaying the contents of the drive in Norton's familiar two-window mode. It offers full support for HPFS drives, including filenames that have mixed uppercase and lowercase, have spaces, or are longer than the FAT 8.3 format.

You even have a choice on how the two windows will appear. The default mode displays the files in the same manner as The Norton Commander for DOS, with both windows showing a directory tree and the files in the current directory. Each window can show a different directory or drive, making it easy to compare, copy, or move files

from one to another. A pull-down drive list makes it easy to change the display from one drive to another.

The alternate display mode duplicates the appearance of The Norton Desktop for Windows, with the current drive's directory tree in the left window and the files in the current directory in the right window. You can also change the left window to a file display, and have the same file management flexibility as you do in Commander mode. The Desktop mode also uses a pull-down list to change the current drive.

Either way, the bottom of the window has a number of buttons that let you view the contents of the current file in ASCII mode, edit the file using the editor of your choice, copy or move it elsewhere, delete it, make a new directory, and sort the file display by name or extension. Other options available from the various pull-down menus let you delete whole di-

rectories and their subdirectories and sort the display by file date or size. There is a Compare choice that compares the files in the two displayed directories

DOS command-line session. The Run menu option brings up a dialog box command line that allows you to start a specific program and specify any command line parameters. Of course, you can also start a program by clicking on its icon in the file display window.

Also included is a user menu utility that can be run from The Norton Commander for OS/2's menu or directly from the desktop or command line. While not



SHELL HELP: Suddenly, the workplace is easy to use.

and highlights the ones that are different.

You can set up filters that limit the files that are displayed. The filter can be for all files, program files only (.BAT, .CMD, .COM and .EXE), or a custom filter. You can change the display font to any font available in the system, including those available through OS/2's built-in Adobe Type Manager.

There is also a file finder built in to let you search for a file across the entire drive and view or run it from the Find dialog box. Unfortunately, there's no equivalent to The Norton Desktop for Windows' SuperFind utility, which allows you to search multiple drives; this would be a nice addition to a future version of The Norton Commander for OS/2.

COMMAND LINES AND MENUS

Pull-down menu choices let you start a full-screen or windowed OS/2 session or a windowed

absolutely necessary, the menu utility gives you an easy way to group all your common applications in one display. User menus can be made read-only by hiding the menu bar that lets you configure them. This makes the utility handy for creating shared user menus on a LAN. The user menu utility can be added to the startup folder, and it will immediately be available whenever OS/2 starts up.

The Norton Commander for OS/2 is a very handy utility that makes file management under OS/2 2.0 a breeze. Just as The Norton Commander for DOS is full of features that DOS should have always included, and just as The Norton Desktop for Windows reminds you of all things that Windows forgot, The Norton Commander for OS/2 makes OS/2 behave as it should. If you've taken the OS/2 plunge and use it extensively, you should have a copy on your system. □

▶ FACT FILE

**The Norton
Commander for OS/2
Version 1.0**

Symantec Corp., 10201 Torre
Ave., Cupertino, CA 95014;
800-441-7234, 408-252-3570;
fax, 408-255-3344

List price: \$149

Requires: 4MB RAM, 500K hard disk
space, OS/2 2.0 or later

In short: The Norton Commander for
OS/2 brings easy file management to
OS/2 in a format familiar to users of The
Norton Commander for DOS or The
Norton Desktop for Windows. OS/2 users
who have large hard disks or who
use the HPFS will want a copy on their
system.

N428 ON READER SERVICE CARD

The Best Way To Send, Receive and Manage Faxes

Introducing WinFax PRO 3.0

WinFax PRO 2.0 made it easy to send and receive faxes, winning *PC Magazine's* prestigious Best of 1991 award in the process. But we didn't stop there. New WinFax PRO 3.0 changes the face of PC faxing once again, putting a full spectrum of powerful tools at your fingertips.

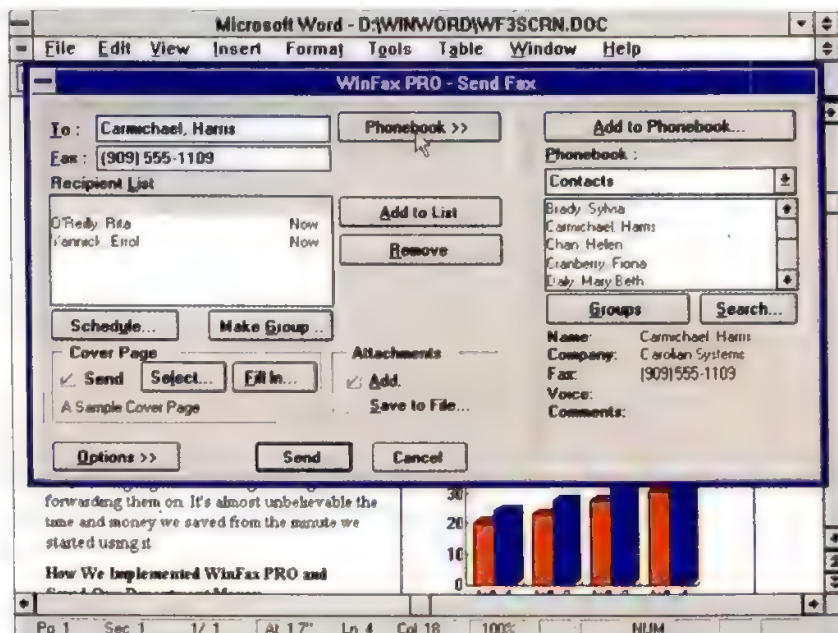
The Freedom of PC Faxing

Now, you can "one button" fax from any Windows application to any fax machine in the world. Easily combine documents from multiple applications and fax to individuals or groups anytime you want. All from the convenience and privacy of your own PC. The wasted time and aggravation of old-fashioned faxing is a thing of the past.

Powerful Tools To Manage Your Faxes

WinFax PRO's advanced document management tools enable you to file, track and quickly find the faxes you've sent or received. Mark up faxed documents right on screen, using our fully featured text and graphic annotation tools. And AnyFax™, the most advanced OCR software for faxes, directly converts them for editing in your favorite word processor or spreadsheet.

Plus, as a special introductory offer, WinFax PRO 3.0 contains Cover Your Fax™ — a FREE \$39.95 value — for a limited time only. 101 great fax cover pages to suit all occasions. Perfect for your business or personal use.



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- Organize faxes for easy retrieval
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"The best faxing software money can buy." *PC Computing*

"If you're looking for fax software, get anything with Delrina's name on it." *John C. Dvorak
Syndicated Columnist*

"A small software miracle." *PC Magazine*

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WinFax PRO 2.0



WinFax PRO 3.0



WinFax PRO 2.0



Communications Software The Wire: First Windows Front End for MCI Mail

BY RICK AYRE

Swfte International Ltd.'s \$99.95 The Wire for MCI Mail, Version 1.0, the first Microsoft Windows front end for MCI Mail we've seen, is a beautifully designed Windows application. It's easy for novices to use, with features that power users will appreciate as well.

When you join the MCI Mail electronic mail service, you are given a unique address. Like an electronic post office, MCI routes messages to you and from you. Messages can be sent to other MCI Mail members or to fax machines, telexes, or as regular U.S. Mail. You can also send binary files as message attachments.

Most popular communications programs will link to MCI Mail, but using them forces you to learn the cryptic commands needed to talk to the MCI computers. That's what The Wire takes care of for you; it automates access to all of the MCI Mail functionality.

THE GRAPHICAL WAY

It is also the graphical way to do e-mail. There are icons everywhere, and almost everything you touch is part of a drag-and-drop interface that pretty much works the way you think it should.

Messages appear as little envelopes; a message that has been read appears as an envelope with the corner torn off; priority mail looks like it's on fire; and messages with attachments are part envelope, part disk. Sure it's got a high cuteness quotient, but it's also functional.

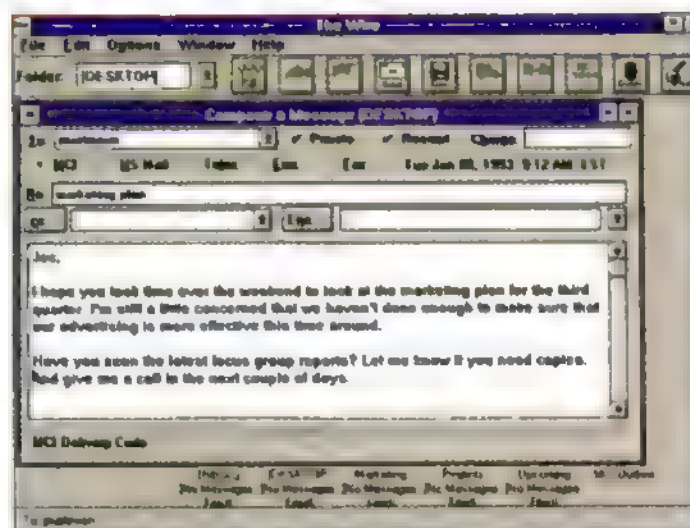
The toolbar across the top of the screen is well designed, too. To delete a message you can select the message and hit the delete key, but all you really have to do is drag the message to the delete button on the toolbar. It's

the same to move or forward a message. There is a consistency to the interface that makes using the program simple.

For power users there are folders for storing messages, and a suitcase so you can take selected messages home or on the road. There is also a Find dialog box (click on the Find button) that helps you search through your e-

mail for the message you need.

The Wire is not perfect. The seriously addicted e-mail user will note the inability to nest



GUI MCI MAIL: The Wire turns MCI Mail into a push-button comm system.

folders, and the addressing scheme, while easy to figure out, is not flexible.

Still, after using The Wire, novices and experts alike may wonder why it took so long for a good MCI Mail front end to come along.

•List price: *The Wire for MCI Mail, Version 1.0*, \$99.95 Requires: 2MB RAM, Microsoft Windows 3.1. Swfte International Ltd., Stone Mill Office Park, 724 Yorklyn Rd., Hockessin, DE 19707; 800-237-9383, 302-234-1740; fax, 302-234-1760.

Circle 426 on reader service card

Windows Utilities Multiple Desktops Are Direct Access Desktop's Best Feature

BY BARRY SIMON

The war of the kitchen sink utilities has come to Microsoft Windows. Symantec Corp. has long ruled as the all-in-one utility champ with The Norton Desktop for Windows, but Fifth Generation Systems has entered the fray with the \$129 Direct Access Desktop (DAD) for Windows.

Included in DAD are multiple virtual desktop views; a program launcher; a file manager; Fifth Generation's entry-level backup, Fastback Express for Windows; an antivirus utility; and a file editor.

The virtual desktops are nine separate full-screen compartments in which you run programs. You can move between compartments by calling up the special task manager that DAD installs, by using the pull-down list under the special icon added to any active window title bar, or by shifting to the control room.

Most virtual desktops provide multiple screens by making Windows act as if the screen were larger than it is. DAD uses a different strategy previously

seen only in Xerox's Rooms for Windows. Programs running in compartments other than the active one are hidden (using an attribute that Windows allows some windows to have). When you switch desktops, DAD hides the programs in the current compartment.

This provides a clean separation between desktops so that, as in Rooms, each compartment can have its own wallpaper. The

ample, you can configure it to allow the selection of files in multiple directories or drives. It doesn't, however, have file viewers and .ZIP archive managers.

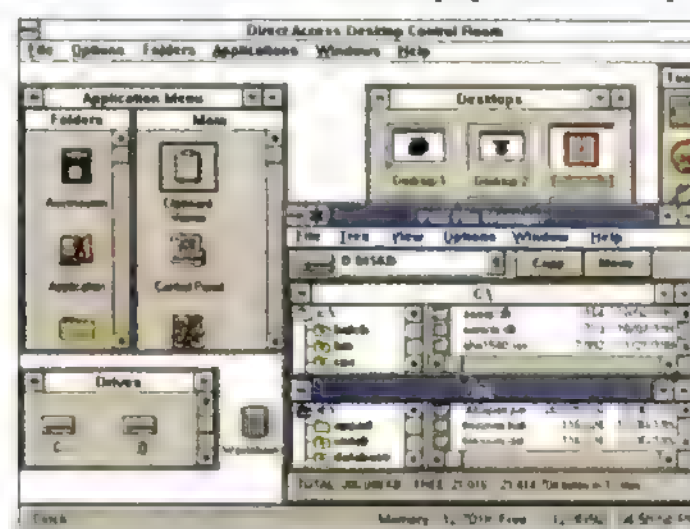
Fastback Express supports high speed backups and compression. You can back up all files, all changed files, or a set of files that you choose on the fly. You can only restore files to their original location, and there is no tape support.

The virus program has a scanner and a resident component, and the scanner can look inside .ZIP files and other archives. The editor allows multiple files and a single-level undo, but has the same individual file-size limit as Windows' Notepad (about 45K).

The multiple desktops are DAD's most attractive feature. On the whole, the product is a little underpowered for the stiff competition it faces, not only from Norton Desktop, but also from other single purpose Windows utilities.

•List price: *Direct Access Desktop, Version 1.0*, \$129. Requires: 2MB RAM, 6.5MB hard disk space, Microsoft Windows 3.0 or later. Fifth Generation Systems, 10049 N. Reiger Rd., Baton Rouge, LA 70809; 800-766-7283, 504-291-7221; fax, 504-295-3268.

Circle 419 on reader service card



DAD'S CONTROL ROOM: The center of activity.

downside is that Alt-Tab task switching only allows access to programs in the current compartment.

The included File Manager has a more robust selection mechanism than does the one supplied with Windows. For ex-

■ Communications

TyIN2000: A \$279 Solution For All Your Communications

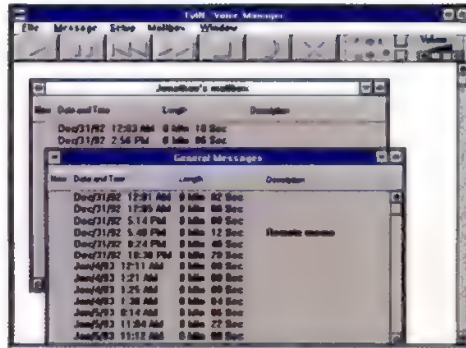
BY JONATHAN MATZKIN

When The Complete PC introduced The Complete Communicator, it seemed like a miracle of engineering ingenuity. For an eminently reasonable list price of \$899, the board packed a full-featured voice mail system, send and receive fax capabilities, and a 2,400-bit-per-second data modem onto a single full-length expansion card.

Just a few years later, National Semiconductor Corp. has crammed similar capabilities into the TyIN2000 PC Communications Center, a three-quarter length add-in board that costs a mere \$279. Not to be outdone, The Complete PC recently dropped the price for the original Complete Communicator (First Looks, April 28, 1992) to \$499 and has introduced both high-end (the \$699 Complete Communicator Gold) and low-end (the \$199 Complete Communicator EZ) versions of its product.

The same competition that has sent PC prices tumbling

seems to have brought plummeting prices and enhanced functionality to this emerging category of multifunction communication hardware.



KEEP TRACK: Messages for each TyIN2000 mailbox are stored in separate windows.

EASY INSTALLATION

Hardware installation for the TyIN2000 amounts to choosing a serial port by setting a single jumper and then popping the board into an available slot. Unlike the Complete Communicator, the TyIN2000 supports all four available comm ports under Microsoft Windows, which simplifies installation in systems that already contain one or more serial devices.

Background voice mail and fax scheduling software, which eats about 85K of RAM, can be loaded high to monitor incoming calls whether or not the TyIN2000's Windows application software is loaded and running.

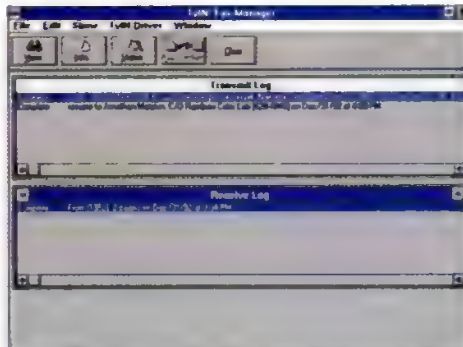
Unlike The Complete Communicator, the TyIN2000 does not come with DOS-based as well as Windows-based application software; this is definitely a Microsoft Windows product through and through.

The Windows installation routine creates a program group

that includes icons for the TyIN2000's Fax Manager and Voice Manager software components. The install program also installs the TyIN2000 driver

as the default printer driver for all Windows apps, which allows you to transmit a fax from any Windows application by simply sending a document to the printer as you normally would. It's convenient but sometimes a little annoying to have that choice made for you.

The TyIN2000's Voice Manager lets you define as many mailboxes as your disk space will allow, and displays messages for each mailbox in a sepa-



FAX MANAGER: A progress screen keeps tabs on your fax documents.

rate window. The TyIN2000 also allows you to dictate voice "memos" using either the handset or an optional microphone; memos are stored in mailboxes along with ordinary phone messages.

MESSAGE ARCHIVING

Password protection controls access to stored messages and a host of remote operations, in-

cluding the recording of outgoing messages and remote pickup of messages from any Touch-tone phone.

The Fax Manager supports many of the same functions as the Complete Communicator's fax facility. You can schedule transmission for a future time, forward received faxes, and broadcast faxes to multiple destinations. Scanner support, however, is weak. The TyIN2000 supports only Logitech's ScanMan Model 256 scanner, a hand scanner useful mainly for including small graphics in documents. The Complete Communicator, on the other hand, supports The Complete PC's full- and half-page scanners, making it more suitable for uses normally reserved for standalone fax machines.

TyIN2000's 2,400-bps data modem has several features that the Complete Communicator lacks, starting with an on-board speaker. The speaker isn't loud enough to monitor phone messages, but it's just fine for following the grunts and groans that signal the establishment of a modem connection. The data modem supports V.22 bis, V.42, V.42 bis, and MNP 2-5 protocols.

VOICE ANNOTATIONS

A few other unique functions set the TyIN2000 apart. The program allows you to attach voice annotations to any Windows document, using the handset as an input device. The board also enables the transmission of binary files, using the DFT (Document File Transfer) standard, to any device that supports the standard, at the 9,600-bps rate of fax transmissions. The process uses the Fax Manager, and is basically as simple as sending a fax document.

If you don't need to scan in documents before sending them, the TyIN2000 can solve many of your communications problems at an exceptionally low price. □

FACT FILE

TyIN2000 PC Communications Center

National Semiconductor Corp.,
2900 Semiconductor Dr., Santa Clara, CA 95052; 800-538-8510, 408-721-5020; fax, 408-721-7662

List price: \$279

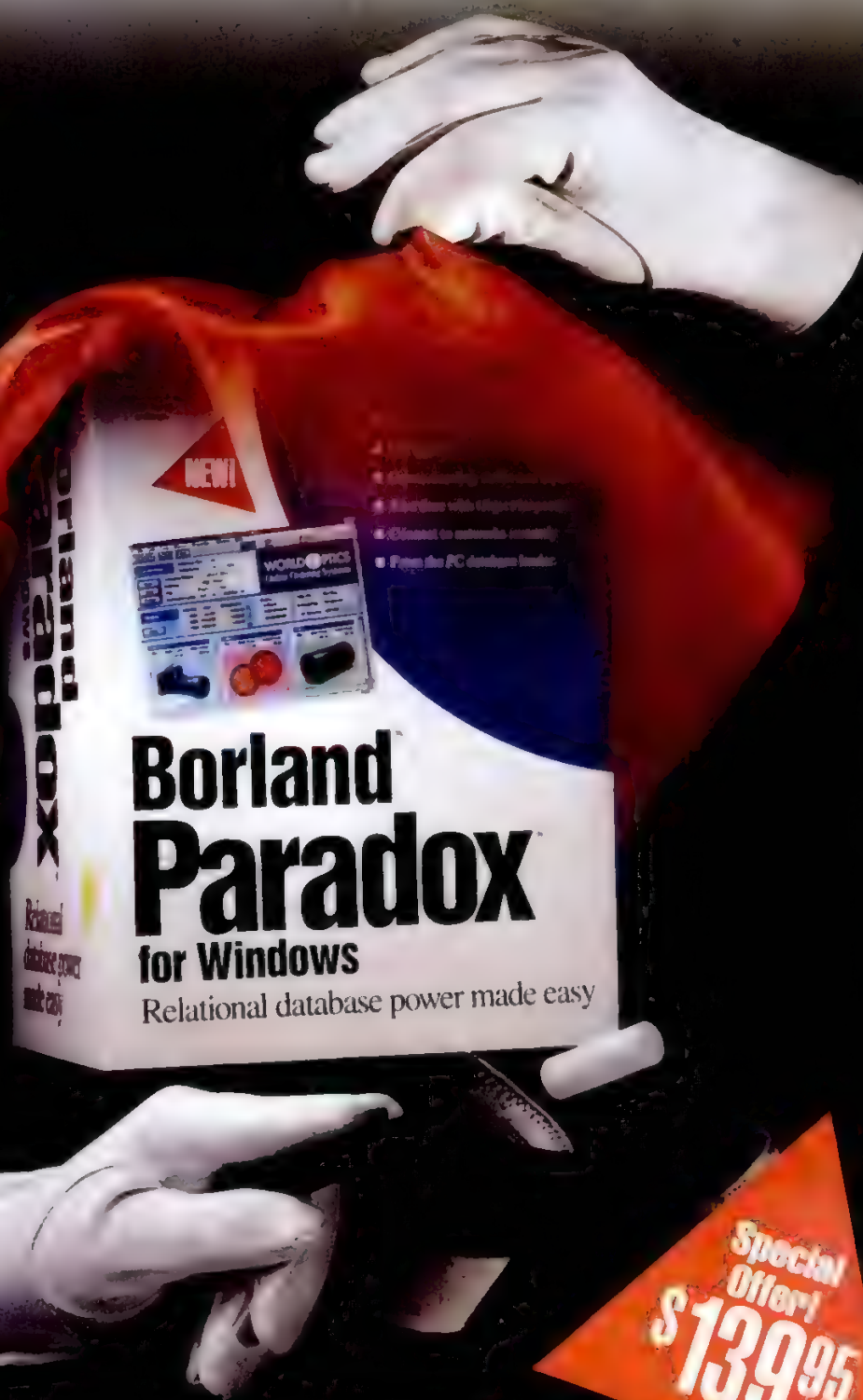
Requires: 2MB RAM, 2MB hard disk space, analog phone line, Microsoft Windows 3.x or later

In short: A Windows-based solution for voice mail, fax, and data modem operations that also supports voice annotation of Windows documents

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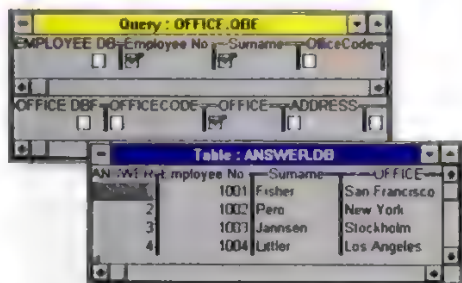


▲ SpeedBar™ icons provide point-and-click access to the features you use most often.

access, modify, and present your data. Object Inspector™ menus make it easy to use all the features and functions of your database, without digging through

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Paradox for Windows is built from the ground up to let you take full advantage of the Windows environment. But unlike other Windows databases, Paradox makes it easy to move between DOS and Windows. You get full table and index compatibility with Paradox for DOS and dBASE. Plus, you get a familiar table viewer, consistent QBE, the same validity checks, password encryption, and more.



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—PC World, August 1992

there's no limit to what you can do: Create customer lists in seconds, automatically generate reports with the push of a button, or retrieve data from



- ▶ Easiest to learn and use
- ▶ Relational database power
- ▶ Create graphical forms and reports with ease
- ▶ Get instant answers to queries
- ▶ Effortlessly access your existing Paradox and dBASE data

Paradox for Windows

File Edit Form Record Properties Window Help

WORLD OPTICS

Online Ordering Systems

Customer

New Find Delete

Customer No: 201
Telephone: +44-71-123456
Company Name: The Camera Shop
Address: 22 High Street
City: Mayfair, London
Zip/Postal Code: SW1 1RG Country: UK

Ship via: One Day
Ordered by: Telephone
P.O. Number: GRT300

Status:
• In Stock
• Back Ordered
• Discontinued

Order

Print

Order No	Date	Total Amount
2209	1-Jan-92	1,109.00
2286	2-Feb-92	1,235.23
2350	3-Mar-92	1,913.55

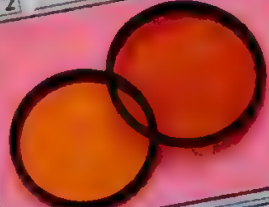
Camera

Qty	Unit Price	Total Price
2	1,195.00	2,390.00



Filters

Qty	Unit Price	Total Price
2	19.00	38.00



Lens

Qty	Unit Price	Total Price
1	295.00	295.00



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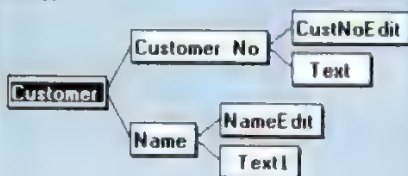
Relational database power made easy

DEVELOPERS CORNER

Unlimited applications development

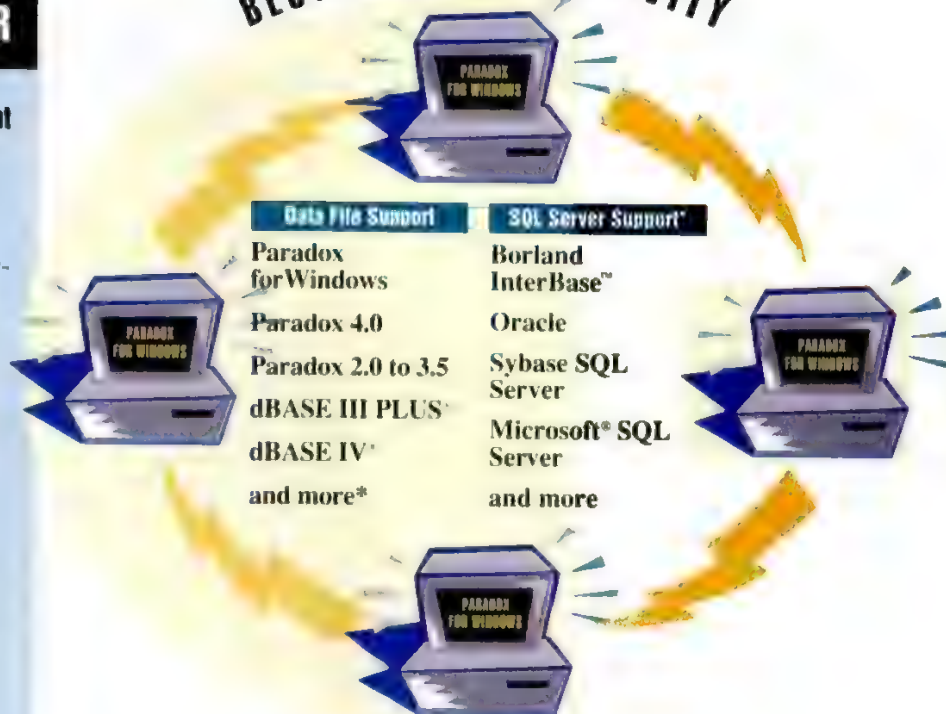
Paradox for Windows enables programmers to create graphically rich custom applications never before possible. ObjectPAL™—a fully structured, high-level language—gives you the benefits of object-oriented programming with easy-to-use, event-driven methods, procedures, and objects. You learn ObjectPAL at your own pace, starting with the basic tools. Then, use the Productivity Switch to turn on more sophisticated features.

Paradox for Windows is perfect for creating fully integrated custom applications for both single- and multiuser systems. A graphical development environment lets you work in Windows to develop and debug your graphical applications. Powerful features like an Object Tree, debugger, built-in editor, and extensive on-line help let you create fantastic Windows applications in record time.



▲ Paradox for Windows' Object Tree helps you build graphical applications fast.

BEST DATA CONNECTIVITY

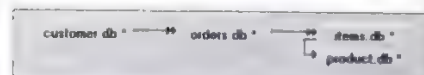


▲ Paradox for Windows lets you easily put all your data to work, without limitations.

The best way to manage your Paradox and dBASE data

No other Windows database gives you complete access to your existing Paradox and dBASE data. You can build multi-table forms, reports, or queries with any combination of Paradox or dBASE tables—and maintain referential integrity and data security automatically! Just select the tables you want, and Paradox for Windows handles

all the work of managing data types and formats for you.



▲ Paradox for Windows allows you to graphically perform relational links to visually see how the tables are related.

New graphical data types

Whether you work on a stand-alone computer or a multiuser network, Paradox for Windows provides seamless, secure con-

Paradox is the best Windows database

USABILITY	Paradox	Access	DATA CONNECTIVITY, continued	Paradox	Access
Insert 1,000 records ¹	29 sec	147 sec	Unlimited secondary indexing	•	
Range select: 15,000 of 130,000 records ¹	<1 sec	16 sec	Creation of dBASE field and expression indexes	•	
Graphical form and report design tools	•	•	Cascading updates in referential integrity	•	
Graphical Query By Example	•	•	SAG CLI-compliant middleware connectivity built-in	•	•
Object inspection menus with right mouse button	•		Table encryption and security	•	•
Visual data modeling for forms, reports, and queries	•		Paradox 4.0 and dBASE IV multiuser concurrency	•	
Full edit capabilities in multi-table forms	•				
Built-in data types: graphic, formatted memo, binary large objects	•		APPLICATION DEVELOPMENT		
			Event-driven programming	•	•
			Object-oriented development environment	•	
			Programming Productivity Switch	•	
			Graphical object management tools	•	
			Database-specific programming language	•	
DATA CONNECTIVITY					
Full native support for Paradox and dBASE tables	•				
Direct creation of Paradox and dBASE tables	•				

nections to an unprecedented array of data types. You can work with text, numbers, and unlimited length memo fields, complete with graphical attributes like font, size, color, and style. Or work with graphic fields that contain bitmapped pictures, OLE fields that store objects from other Windows applications like spreadsheets and word processors, and even

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▲ Creating reports that include graphics, text, and design objects is easy! It's almost like having a desktop publisher inside your database.

CIRCLE 220 ON READER SERVICE CARD

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■ Presentation Graphics

WordPerfect Presentations: DOS Lives for Graphics

BY CAROL ELLISON

Imagine a graphics product that looks at graphics the way you do. It lets you draw, paint, and access all of your favorite graphics tools where they are handiest: on the drawing screen. It displays your charts as you enter new spreadsheet data and converts a written outline to word charts. It lets you view your presentation in a slide sorter and play with transitions—both sound and visual—to your heart's content.

Now imagine doing all this without Microsoft Windows, and you've got the \$495 WordPerfect Presentations. Nowhere else in the DOS world will you find a combination of charting, drawing, painting, sound, and slide-presentation capabilities like the combination you'll find here. WordPerfect Presentations brings presentations about as close to interactive multimedia productions as a DOS-based program can get. If you haven't succumbed to the lure of the interactive graphical applications in Windows, here's a product that just may keep you in the DOS environment a little while longer.

PRESENTATION PERFECT

Version 2.0 is the robust upgrade of WordPerfect's DrawPerfect, a drawing program that complemented the company's word processor but never stood up on its own. While DrawPerfect is designed to create charts and graphics for use in WordPerfect documents, WordPerfect Pre-



SPECIAL EFFECTS: You can apply 3-D perspective to your graphs.

sentations is designed to compete with the most powerful presentation programs for both DOS and Windows. It does.

WordPerfect Presentations doesn't abandon WordPerfect users. While its attractive interface offers graphical tools, menus, and push buttons, its function keys conform to many of those in WordPerfect. Exit,

their way around. Even WordPerfect mavens are likely to abandon the function keys for the customizable toolbars.

The program features a variety of templates that use preset combinations of palettes, font styles and sizes, and editable charts that make it a snap to compose quick presentations. The program ships with 10 Bitstream Speedo and 30 Adobe Type Manager Type 1 fonts, and features a font installer for adding more Speedo or PostScript fonts.

The Master Gallery contains a variety of customizable templates, including three-dimensional and organizational charts, and a functioning spreadsheet makes it easy to enter and analyze data within the program. It also imports worksheets from Lotus 1-2-3, Microsoft Excel, and Borland's Quattro Pro.

WordPerfect Presentations can also generate speaker's notes and check spelling—features first made popular by its competitor, Harvard Graphics. But unlike the DOS version of Harvard Graphics, WordPerfect Presentations integrates

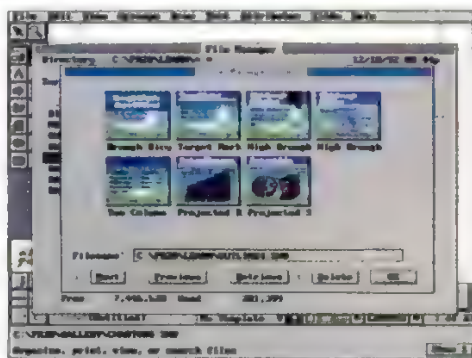
draw, paint, and presentation features in a virtually seamless manner. Slide preparation takes place entirely on a single screen, with only minor side steps into distinct modules. A file manager lets you preview (or prehear) your selections before importing them into your presentation, making it easy to find specific files, chart templates, clip art, and sound files.

DRAW AND PAINT SETS

Artists will enjoy a full complement of drawing and painting tools and more than 1,000 editable clip-art images. The program supports more than 20 different sound cards, including the Sound Blaster from Creative Labs and various cards from Roland, and ships with 130 MIDI files featuring everything from a dog's bark to jazz sequences. You can also associate individual slides with voice-recorded .WAV files, adjust the volume on individual slides, and set the sounds to play once or repeat in a loop.

A painter's palette icon accesses the paint features, complete with a pixel editor for pixel-by-pixel changes. Clicking on the icon zooms you to a separate screen which accesses paint tools. These tools include

• *Continues on page 53*



FILE MANAGER: Preview and rearrange your slides and charts.

for instance, is still F7, and Help remains F3, although in this version, WordPerfect also offers it on F1. But the features are so easily accessed from the menus and tools that newcomers barely need to crack the manual to find

WordPerfect Presentations, Version 2.0

WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; 800-451-5151, 801-228-9912; fax: 801-222-5577

List price: \$495 Upgrade from DrawPerfect \$99, competitive upgrade, \$129

Requires: 512K RAM, 6MB hard disk space, DOS 3.0 or later

In short: A DOS-based presentation graphics program with strong drawing, painting, charting, spreadsheet, and sound features. It rivals the best DOS and Windows competitors and is another good reason to stick with DOS

ON READER SERVICE CARD

WordPerfect

CONTINUED FROM PAGE 52

brushes, a spill bucket, a spray can, and an autotrace feature that converts imported bitmap files into editable drawings.

For easily importing images, the program detects a variety of popular bitmap formats, including .PCX and TIFF, and translates them without user intervention. When you have finished painting, a simple click on a radio button brings the painting into the draw screen for further modification with a number of effects, such as flipping it from front to back or from left to right.

Drawing abilities are also impressive. The Contour Text feature wraps text to fit the outline of an object. You can drag objects and size them using handles and click the right mouse button to bring up context-sensitive menus. In fact, the program's mouse support represents a major step up from DrawPerfect.

The program supports radial and linear gradients, color blends within and across objects, and customized palettes of up to 256 colors, created from a palette of more

than 16 million colors. You can export completed drawings into 13 different file formats, including EPS, .PCX, SCODL, and TIFF.

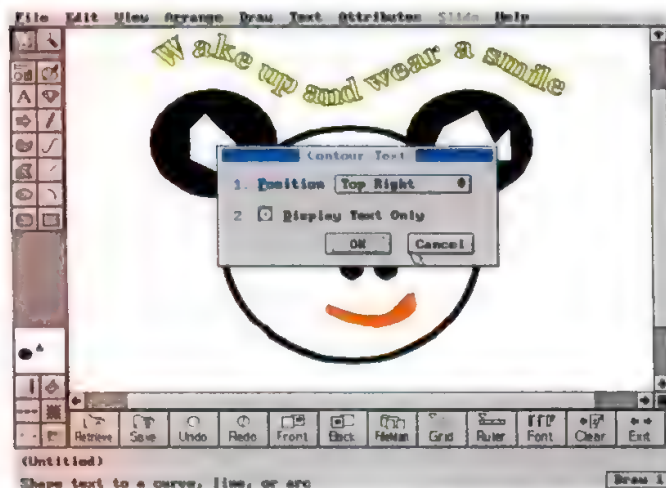
Of course, DOS still has its limits. The program will run under Windows, but it must operate on a full-screen basis. We were able to run it without complications on a 386-based system with 4MB of RAM by setting file handles to 80, but task-switching was slow.



To download a working model of WordPerfect Presentations from PC Mag-Net, type GO ZNT:DEMOS from any CompuServe prompt. From February 8 until February 12, you can go on-line to discuss the program with Carol Ellison and a WordPerfect Presentations product marketing executive. Type GO ZNT:EXEC.

If the features in WordPerfect Presentations sound familiar, it may be because you've read of similar features that are in Windows-based drawing and presentation products such as Harvard Graphics for Windows and Corel-DRAW. While the program competes well with the Windows products, it breaks no new ground there. (WordPerfect expects to unveil Presentations for Windows soon. It will likely include all the features of the DOS product, along with more comprehensive multimedia support.) But WordPerfect Presentations

for DOS stands out on the DOS front by offering the most comprehensive and interactive feature set available thus far. □



CONTOUR TEXT: One of the program's high-end features.

Information Systems

Open EIS Pak Connects Windows Applications

BY CRAIG STINSON

With its \$99 Open EIS Pak, Microsoft proposes a redefinition of the concept of an executive information system. Rather than program such systems from scratch, why not take off-the-shelf Windows applications—Microsoft's as well as other vendors'—and glue them together with OLE, DDE, and a bit of macro programming?

To promote this vision, the EIS Pak offers an easy-to-use application generator built with Excel's macro language, a suite of persuasive sample EISs, and lots of inspirational materials.

The core of the package is the application generator, called the Microsoft Excel EIS Builder. You invoke it by opening an add-in macro in Excel, and the end result of working with it is a large Excel add-in macro. But the EIS Builder shields you from most of Excel's macro language.

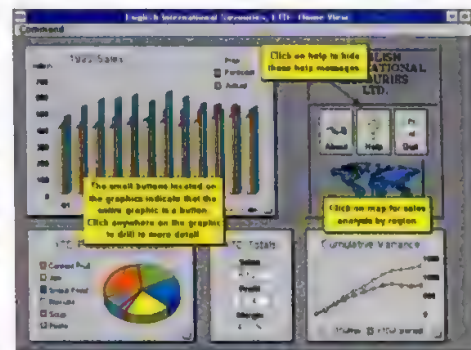
To build an EIS with this tool, you begin by setting up the various views that the end user is to see in the finished product. These may be Excel tables or charts, printed reports, or screens created in other Windows programs. With the help of EIS Builder dialog boxes, you add buttons and hot zones to views, create custom menus, and set up DDE or OLE links between applications.

The EIS Builder has an extensible library of procedures, which you can use as building blocks for scripts. To make an object (like a button or hot zone) do useful work, you create the object (by selecting from a

list of supplied object types) and choose a Script command.

To create your script, you select an action class, choose an action, click an Add button, fill out a dialog box with options relevant to the chosen action, then repeat the steps until all actions have been added to the script. Scripts may be named for easy reuse in other contexts.

None of this requires deep knowledge of Excel program-



DRILL DOWN: Open EIS Pak lets you create your own enterprise information system.

ming. But you must have Excel itself, and to use it effectively requires worksheet- and chart-level Excel expertise.

Other core programs—such as Visual Basic or a database system—might be more appropriate for certain applications, but the EIS Builder's time-saving potential should make it a must-have item for anyone who develops applications in Excel. And for developers of corporate information systems in companies standardized on Windows, the demonstration programs alone may well justify the Open EIS Pak's bargain price.

•List price: Microsoft Open EIS Pak, \$99. Requires: 4MB RAM, Microsoft Windows 3.0 or later, Microsoft Excel 4.0. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679, 206-882-8080; fax, 206-936-7329.

Circle 423 on reader service card

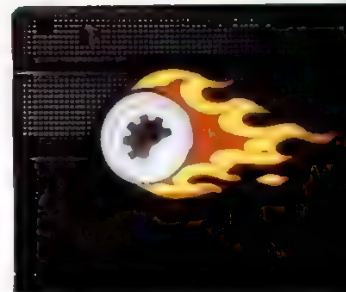
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■ SCSI

Adaptec's Easy SCSI: New Adapters and Software

BY JAMES KARNEY

The confusing maze of SCSI (small computer system interface) drivers, cables, and settings can make hooking up a system with SCSI devices quite a challenge, but with the advent of multimedia and the growing popularity of CD-ROM drives, there's increasing demand for SCSI systems.

SCSI offers better throughput and saves slots, since several devices can be linked to one host adapter. The problem is that, since DOS doesn't directly support the interface, each device requires a separate driver and precise installation on the SCSI bus. Many devices are designed to require a specific adapter card.

Fortunately, there's a solution. Adaptec's \$466 combination of its ISA-based AHA-1542C SCSI-2 bus-mastering host adapter and its EZ-SCSI software, bundled together under the name The SCSI Master Plus, goes a long way toward making *easy* and *SCSI* almost synonymous.

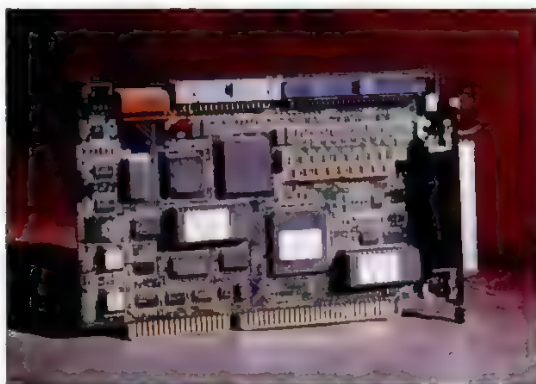
NO JUMPERS

There are no jumpers on Adaptec's new adapter. You set the IRQ and I/O address on the card's single DIP switch and place it in a free 16-bit slot. Termination, ID numbers, and other SCSI arcana are all handled via software setup menus.

The accompanying EZ-SCSI software is designed to automatically configure almost any device compatible with ASPI (Advanced SCSI Programming

Interface). It also includes formatting, partitioning, and bus-query utilities.

The result: A system can be up and running in minutes, rather than after hours of playing with jumpers and terminator blocks. The EZ-SCSI software is



HOST ADAPTER: Add external devices in a snap.

also able to identify and manage any other Adaptec host adapters you may have as part of your system.

There are two versions of the adapter. The \$289 AHA-1540C provides internal and external device connections as well as BIOS-level hard disk support. The 1542C (\$299 when bought separately from the package deal) is identical, but it adds a floppy disk controller. Both versions provide bus-mastering and multithread I/O, allowing 10MB per second operation. Both versions can also handle hard disk sizes up to 8 gigabytes. An on-board 10-MHz processor handles SCSI protocols, freeing the system's CPU.

TORTURE TEST

All this talk of simple installation may sound too good to be true to anyone who has ever installed a SCSI system. We tested the new hardware/software combination in a 33-MHz 486 ISA-based PC with 16MB of

RAM, a Micropolis 2105 SCSI-2 hard disk, a Toshiba 3301 CD-ROM, a Corel Kurata Phase-Change rewriteable optical drive, and a Colorado Memory Systems' (CMS) QIC PowerTape unit. To complicate things, the CMS unit requires a different Adaptec host adapter (AHA-1510), and we placed the Kurata and CD-ROM on a Corel LS-200 adapter for part of the test. While we encountered some limitations, the 1542C and EZ-SCSI software did an admirable installation job.

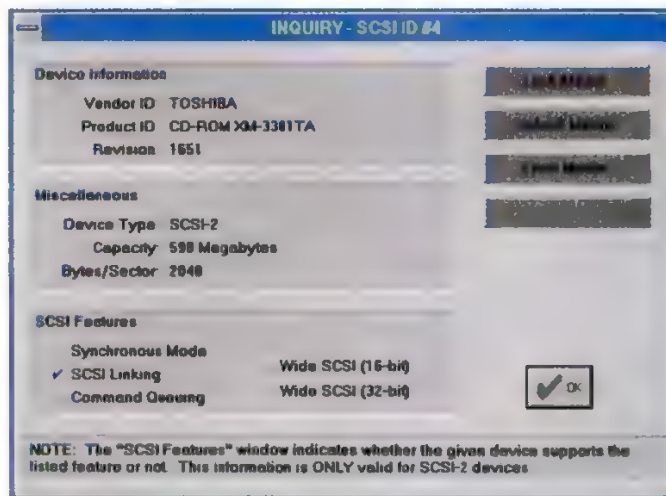
Installing the host adapter was easy. While we did have to try a few different address settings, the card worked well once a free location was identified. The host adapter's BIOS includes routines for running two hard disks without any software drivers, plus utilities for media testing as well as low-level formats. It properly identified the Micropolis disk, which was used as the primary drive

for the entire test. We partitioned the hard disk into four areas, under both DOS 5.0 and OS/2 2.0.

The next step was to install the EZ-SCSI software, which provides the automatic installation, drivers, and utilities for managing all ASPI-compatible devices on the system. It also has tools for formatting and partitioning hard disks that aren't directly controlled by the adapter card's BIOS.

Then we added the CMS PowerTape, its 1510 host, and a proprietary backup program to the DOS system. Running the EZ-SCSI setup was straightforward, and both adapters ran under the ASPI driver without any problem. The software accurately reported the types of devices, loaded the right drivers, then made the required changes to the CONFIG.SYS and AUTOEXEC.BAT files. During the boot cycle, the current settings and status of each adapter and device were displayed as the drivers were loaded.

The Kurata Phase-Change drive presented more of a challenge. It had been formatted with 1,024 sectors per track using CorelSCSI, while the Adaptec driver support is limited to drives with 512 sectors per track. It wasn't a significant problem, though. We just placed the LS-200 host adapter in a free slot, made sure there were no



SCSI MENUS: The Adaptec SCSI Interrogator is an easy way to get information about your SCSI devices.

address conflicts, then added the appropriate Corel-SCSI driver. Since the Corel products are ASPI-based, everything worked smoothly once all the settings had been fine-tuned. The EZ-SCSI software was able to report the correct form at of the Phase-Change cartridge.

The final step was to shift the Kurata optical drive and the CD-ROM to the external connection on the AHA-1542C and disable the host adapter's termination using the EZ-SCSI menus. The menus are available each time the system is booted, just after the CMOS is read. By holding down the Ctrl-A key combination you can bring up the master menu, which lets you make settings, change the adapter's termination, and adjust the transfer rate from the SCSI to the ISA bus.

Adaptec provides a handy Microsoft Windows-based SCSI utility that lets you see displays of product information, current configuration, and available features for devices and adapters under EZ-SCSI and ASPI control. You can also play music if you've got a DOS-based CD-ROM drive, although the DOS-based player that comes with the Adaptec package isn't

as sophisticated as Corel's CD-Audio Windows player.

SCSI'S PROBLEMS

There are some difficulties with SCSI and DOS that no vendor can overcome. If you plan to use a host adapter in a machine with a high-powered video card and most of its slots filled, you may have problems finding an open slot.

We were unable to get a memory manager to load with the AHA-1542C and a TI-

34020-based true-color video adapter active at the same time in the system. We also encountered some problems in accessing the hard disk after loading a mouse driver when everything was installed and running. In short, the new Adaptec combination will make setting up the SCSI components a snap, but the problems related to address spaces and the limitations of DOS still apply whenever you are adding new components to a system.

Another consideration is the lack of agreement on driver protocols. If a device you want to install is based on Future Domain's CAM (Common Access Method), you'll need another driver and maybe another host adapter. SCSI is not a turn-key solution yet, but the engineers at Adaptec have done a great job of getting us closer to that goal. If you're looking for a new host adapter, the AHA-1542C is the best option currently out there. □

Printer Accessories

PrinterFax Turns LaserJets Into Incoming Fax Machines

BY EDWARD MENDELSON

The cheapest and simplest way to get a plain-paper fax machine is to plug Moonlight Computer Product's \$259 PrinterFax into a cartridge slot on your HP LaserJet printer. Except for a phone jack on one side, the PrinterFax looks like an ordinary font cartridge, but it transforms any LaserJet printer (except the LaserJet IIISi or 4) into a receive-only fax machine.

The PrinterFax is a no-frills solution that can't send outgoing faxes, and can't store incoming ones when you switch your printer off. But if you don't mind getting faxes only when your printer is on, or if you occasionally prefer plain-paper faxes to the output of your fax machine, you'll find that the PrinterFax does the job cheaply and efficiently.

You set up the cartridge through the printer's control panel. The settings you can specify include the number of rings before the cartridge answers the incoming fax, the printout resolution, and the station number that the cartridge reports to the remote fax machine.

You can configure the cartridge to use letter- or legal-size

paper. The image received is slightly reduced to fit on the printable region of the page. If a legal-size fax arrives when the cartridge is set for letter-size



FAX CARTRIDGE: PrinterFax looks like a font cartridge; a phone jack receives faxes.

paper, the last three inches print on a second sheet.

The cartridge does not use disk-based software and does not require cables, except for an ordinary telephone wire. It uses the printer's memory to store incoming faxes and requires at least 1MB of printer RAM; the HP LaserJet II, IIP, or IIIP also require a standard add-in memory card to work with the cartridge.

The PrinterFax is simple and efficient. When a fax arrives, the

cartridge resets the printer into fax mode, uses the printer's LCD panel as a status indicator while receiving and printing the fax, then resets the printer into normal LaserJet mode again. Paper jams won't faze the cartridge, and if a fax arrives while you're printing, the cartridge will let the phone ring until the print job is completed.

Don't buy the PrinterFax if you download fonts to your printer at the start of the day; soft fonts that are in the printer's memory will disappear when a fax arrives. And don't choose it if you use a PostScript cartridge, because both the PostScript and PrinterFax cartridges need to use the left-hand slot on the LaserJet II or III. However, the PrinterFax co-exists with ordinary cartridges that can work in the right-hand slot.

Other LaserJet fax add-ons, like Tall Tree's \$399 Fax-o-Matic or JetFax's \$795 JetFax II, store

incoming faxes when the printer is turned off, but require an external box, a power cord, and extra printer cables. The PrinterFax is inexpensive and easy, and perhaps best of all, your faxes won't curl or fade.

•List price: *PrinterFax*, \$259. Requires: *HP LaserJet II, IID, IIP, III, IIID, IIP, or IIIP Plus. Moonlight Computer Products Inc., 10211 Pacific Mesa Blvd., San Diego, CA 92121; 619-625-0300; fax, 619-625-0199.*

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FACT FILE

The SCSI Master Plus

Adaptec Inc., 691 South Milpitas Blvd., Milpitas, CA 95035; 800-934-2766, 408-945-8600; fax, 408-262-2533

List price: \$466 including adapter and EZ-SCSI software; software sold separately, \$75

Requires: EZ-SCSI: RAM, DOS 4.0 or later, AHA-1542C Adapter: ASPI-compatible SCSI target devices

In short: The combination of a jump-erless SCSI-2 host adapter and an easy-to-use configuration and driver-management program make this hardware/software bundle an attractive option. Anyone adding a SCSI hard disk or CD-ROM drive to a system is likely to save time and effort

416 ON READER SERVICE CARD

■ Mathematical Software

Macsyma: Slow but Steady on Symbolic Math Problems

BY BARRY SIMON

Macsyma was the first symbolic math program to run under Windows, but that first release was ungainly, slow, and three times the price of its \$995 rival, Mathematica.

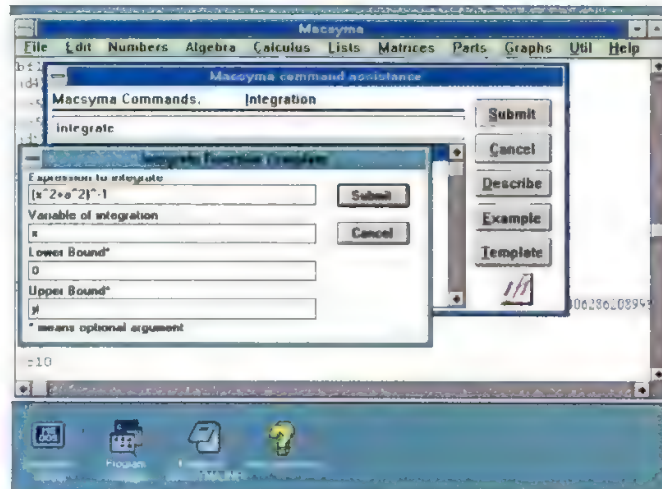
Now, Macsyma has released a new version (with the cryptic release number of 417.125) that aims to capture back its lost market. With an aggressive price of \$349, the best interface, improved graphing, and a solid graphics engine, it just might succeed.

Macsyma has a kernel with the spectacular features we've come to expect from symbolic packages. It does real arithmetic to any prescribed degree of precision, exactly manipulates rationals and surds, and deals with symbols so it can factor polynomials or do symbolic calculus.

It plots a variety of two- and three-dimensional graphs, surfaces, and contour plots with the rulings and color grading made fashionable by Mathematica. You can control color to plot two variables against two others using height and color to display the two outputs. You can export graphs as bitmaps or print them, but there is no export to EPS or other vector graphics formats, and there is no animation feature.

STRONG IN SPECIAL CASES

Macsyma is somewhat stronger than its rivals in dealing with special values and branches of roots. For example, all other programs will return an incorrect answer when asked to integrate x to the power n with respect to n if n is -1 . Only



EASY MATH: You can supply parameters through dialog boxes.

Macsyma bothers to ask you explicitly if n is really -1 . And unlike its rivals, it can correctly compute the gravitational potential of a ball, a problem that requires the correct branch of a square root.

Macsyma's basic input mechanism is unique. As you type, Macsyma parses what you are typing and complains about errors. For example, if you type $2x$ rather than $2*x$ (where $*$ is multiplication), the program forces you to fix it on the spot. The downside is that in this mode, the only editing key is backspace. But hit Ctrl-E and an edit window appears where you can even write multiline programs. Some will find this the best of both worlds, but we often found it awkward.

Macsyma's help system shines. First, there is a standard Windows help file that is well indexed and extensive, but that's just the beginning. The bulk of the menus are an entree into a second demo-filled help system.

Two performance-related problems still need addressing: heavy-duty hardware requirements and overall slow operation. Macsyma needs more RAM than Mathematica and much more than its other primary competitor, Maple. The minimum requirement is 8MB of real RAM and at least 20MB total of RAM plus swap file. More is recommended and

with a 1MB SMARTDrive file) and a 15MB swap file, and also with 12MB RAM free.

Increasing RAM had dramatic results. It took the program 179 seconds to load with the minimal configuration and 67 seconds with the larger memory setup. But with either configuration, the program was very slow.

Out of 23 test problems, Macsyma configured with minimum memory was never faster than Maple (its speediest competitor). It took more than 5 times as long on 14 problems and over 40 times as long on 4 problems. With 12MB, it bested Maple once, was more than 5 times as slow on 8 tests, and over 40 times as slow on 3.

Particularly slow were operations with large precision reals (120 and 105 seconds for a problem that took Maple 1 second) and factoring polynomials (12 and 11 minutes versus 15 seconds).

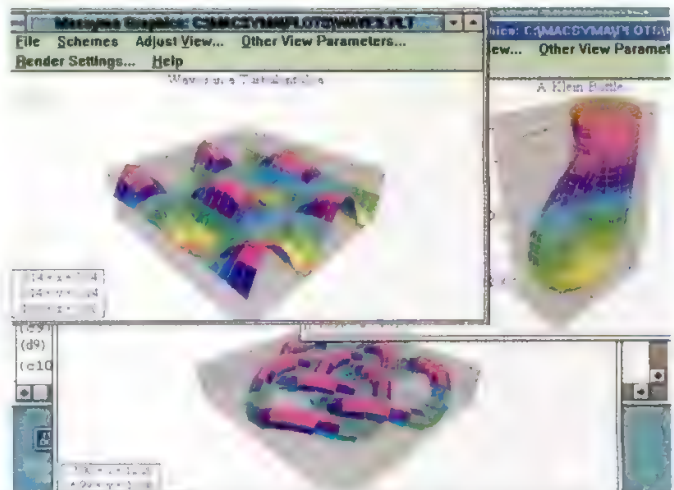
The bottom line: If you want to enjoy Macsyma's improved interface and symbolic math features, use a 486 and don't skimp on memory.

• **List Price:** *Macsyma, Version 417.125*, \$349; upgrade, \$223.50. Requires: 8MB RAM (12MB recommended), 14MB hard disk space, Microsoft Windows 3.1. *Macsyma Inc.*, 20 Academy St., Arlington, MA 02174; 800-622-7962, 617-646-4550; fax, 617-646-3161.

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needed for good performance on large problems.

For testing, we asked Macsyma to provide code for the suite of problems used in our last evaluation ("Symbolic Math Software: It's Not Just for Mainframes Anymore," August 1992) and ran it on a 25-MHz 386 under two scenarios: with 6MB free after Windows loaded (typical for an 8MB machine



NEW DIMENSIONS: Macsyma's 3-D surfaces are stunning.

■ Multimedia

Edit .WAV Files with Digital Soup's Sound Professional

BY ROBERT KENDALL

If you've invested in an expensive audio card for multimedia work, a .WAV file editor can help you get the most out of it. Digital Soup Sound Professional, Version 1.0, a powerful but complex \$99 Microsoft Windows program, is for people who want to do more than just record and play back digitized sound in the .WAV format.

Sound Professional can cut and paste .WAV files, mix dif-

ferent files together, and create a variety of special effects. It handles all of the sampling formats supported by Windows—ranging from 8-bit, 11.025-kHz mono to CD-quality 16-bit, 44.1-kHz stereo—and lets you convert .WAV files to lower sampling qualities to conserve disk space.

The program displays the waveforms of the left and right audio tracks of

your file, letting you select portions for editing. With the aid of a toolbar you can adjust volumes, create fades and echoes, and filter frequencies with an equalizer. You can even alter the duration of a section with-

out changing its pitch, though at the risk of introducing distortion.

Sound Professional gives you 16 audio tracks to work with. Though you can view and play only two tracks at once, you can

store different versions of your audio production on different tracks.

If you want to try out different effects without losing your original, there's an undo feature and an interesting formula feature. Formulas modify sound properties of the track you apply them to without changing the actual sound data.

CD-ROM users can pop up a handy player for controlling audio CD by clicking on tape recorder controls. You also get an audio CD jam-packed with sound effects.

Unfortunately, Digital Soup Sound Professional is extremely difficult to master and often produces unexpected results. Mixing tracks is an especially confusing procedure, and even creating something as simple as a fade-in can be trying. We also encountered some bugs. For example, the Save As .WAV option failed to produce valid .WAV files, though copying selected tracks to a .WAV file worked fine.

You'll also need a 486-based computer to be very productive. On a 25-MHz 386 we were unable to achieve fast enough throughput to record at the highest sample quality, though Turtle Beach Systems' Wave for Windows had no trouble recording on the same machine. Just opening a sizable .WAV file can take several minutes, and some editing options are prohibitively slow.

• List price: Digital Soup Sound Professional, Version 1.0, \$99. Requires: 2MB RAM, sound board, 5MB hard disk space, Microsoft Windows 3.1. Digital Soup Inc., P.O. Box 1340, Brattleboro, VT 05302; 800-793-7356, 802-254-7356; fax, 802-254-6812.

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ON TRACK: Sound Professional displays the waveforms of the tracks of a .WAV file.

■ Subnotebooks

Z-Lite 320L: 4 Pounds of Good Looks, Smart Features

BY GREG PASTRICK

Zenith Data Systems has made a unique mark in the subnotebook category by producing a 4-pound, \$1,899 system that successfully mimics the slim, textured look of an executive's binder. The Z-Lite 320L Model 60 ships with 2MB RAM, a 60MB hard disk, and DOS 5.0 preloaded. A Windows-ready version, the Model 60W, adds a front-mounting pointing device and an external 3.5-inch floppy disk drive; its price is \$2,199.

Looks and competitive pricing aren't the Z-Lite's only sell. Keyboard-launched power management and system setup efficiently optimize the operation of the system's mix of 3.3 and 5-volt components. Standby, rest, and resume modes saved in CMOS rule the Z-Lite's 3.3-volt 20-MHz 386SL CPU, memory, LCD, drives, and

system I/O. All work together to give 3 to 6 hours of battery-powered operation from the subnotebook's reliable nickel-hydrate battery pack.

The Z-Lite's keyboard shows off some intelligent design, too, with its shaved special function keys, inverted-T cursor keys, and its raised keycaps spaced at .72 inches. The 8.5-inch backlit LCD shows 64 shades of gray at standard VGA resolution, while its 16-bit video interface manages simultaneous display from a monitor.

Measuring 1.5 by 9.9 by 7.6 inches (HWD), the Z-Lite tapers to

1.1 inches high at the front, giving you an angled surface for touch-typing. Nevertheless, the system has enough room to offer mouse, parallel, serial, and video ports plus two PCMCIA Type II slots along its spine. Zenith offers three PCMCIA options, including a \$299 Ethernet LAN adapter, a \$369 2,400-/9,600-bps fax modem, and a \$559 9,600-/14,400-bps fax modem.

The Z-Lite's front-mounting pointing device, the \$89 Lite-Point, holds a trackball placed off-center to the left. With your fingers at home position, it becomes a thumbmouse flanked by two buttons.

Looks, features, and functions give the first of ZDS's Z-Lite subnotebooks a solid start in the 4-pound portable class. As additional PCMCIA peripherals become available, it will be even more attractive.

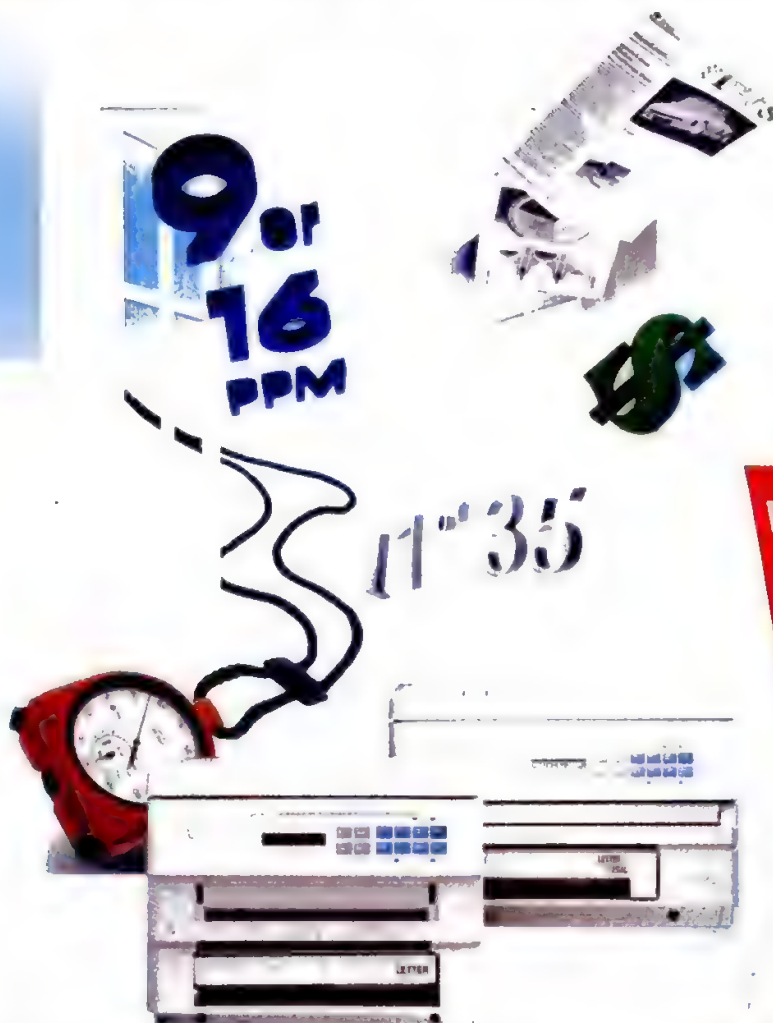
• List price: Zenith Z-Lite Model 60, \$1,899; Model 60W, \$2,199. Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331; fax, 800-472-7211

Circle 427 on reader service card



COMPACT DESIGN: The Z-Lite has an external floppy drive.

Four reasons to buy a TI microLaser™ printer.



Now there's a way for you to put the power of Microsoft® Windows™ on paper — microLaser from Texas Instruments.

Designed to be Windows-compatible, there's a microLaser just right for your needs, whether you need a personal or shared printer. Here's why:

1. Compatibility With HP LaserJet® emulation and Adobe® PostScript® software, microLaser easily supports your demanding applications. And with our Microsoft Windows driver, set it and forget it with all Windows applications.

Not only does PostScript give you scalable outline fonts and graphics, it also means that your microLaser works in computing

environments like Windows, DOS®, Apple® Macintosh®, OS/2® and UNIX®.

2. Performance When it comes to printing high-quality documents fast, microLaser really makes you look good. At either nine or 16 pages-per-minute, microLaser printers speed you through documents in a hurry. Plus PostScript means what you see on your screen is what you get on paper. You can even turbocharge your microLaser with a RISC processor for blazing fast graphics.

3. Reliability When you buy a printer, you want it to print. And print. And print. That's just what the microLaser does.

Take our personal microLaser Plus for

example. With its high duty cycle of 10,000 pages-per-month* and a standard one-year limited warranty**, you can rely on your microLaser to work the first time, every time, for years.

4. Value Starting as low as \$999†, there's a microLaser designed to fit any budget. From the single user all the way up to a network. Consider this, too: microLaser's average cost per page is only 1.9 cents‡, while some laser printers average around 3.3 cents. The microLaser not only makes sense, it saves you money, too.

For details on the right microLaser for you and the name of the nearest dealer, call

1-800-527-3500.

The microLaser PS17 has earned the 1990 PC World Best Buy award; microLaser PS35 has earned the 1990 InfoWorld Excellent Value award and 4½ stars from MacUser, October 1990.

Features	microLaser Plus Basic	microLaser Plus PS17/PS35	microLaser Turbo	microLaser XL Turbo
PPM	9 ppm	9 ppm	9 ppm	16 ppm
Emulation/Processor	HP LaserJet II 68000	HPLJII/PostScript 68000	HPLJII/PostScript II RISC/8220	HPLJII/PostScript II RISC/8220
Fonts	14 HP Fonts	17 or 35 Scalable	35 Scalable	35 Scalable
List Price	\$999	\$1,399/\$1,499	\$1,749	\$3,649

TEXAS INSTRUMENTS

*Based on estimated typical usage. **For more information on service upgrade options, call 1-800-847-5757 in the U.S. and 1-800-268-6314 in Canada. †Suggested retail price — dealer prices may vary. ‡Based on suggested retail price of consumables and approximate page coverage rating for each consumable at 4% black (toner, developer and OPC). microLaser is a trademark of Texas Instruments Incorporated. Microsoft and DOS are registered trademarks, and Windows is a trademark of Microsoft Corporation. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems Incorporated which may be registered in certain jurisdictions. LaserJet is a registered trademark of Hewlett Packard, Inc. Apple and Macintosh are registered trademarks of Apple Computer, Inc. OS/2 is a registered trademark of International Business Machines Corporation. UNIX is a registered trademark of AT&T. ©1992 TI 76543

CIRCLE 353 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Emerson Andrew Torgan

NEW

The Q-DOS Collection: Hard Disk Utilities

Gazelle Systems is shipping The Q-DOS Collection, a hard disk utility bundle that combines the company's currently released products with three new utilities. The Q-DOS Collection contains improved versions of Q-DOS, Gazelle's file and directory manager; Back-It, an automated backup system; and OPTune, a file defragmenter/disk maintenance utility that can increase hard disk space.

Q-DOS has the ability to unerase, copy, rename, move, delete, edit, and manipulate files.



Gazelle's Q-DOS file and directory manager.

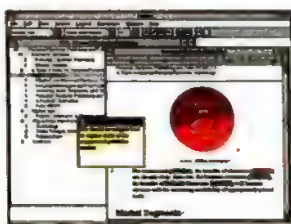
It also has new file viewers for dBASE; FoxPro; Lotus 1-2-3, Release 2.1; Microsoft Word; Paradox; Quattro Pro; WordPerfect; and WordStar. Back-It now supports the new generation of parallel-port drive, and it now features mouse support. OPTune offers three levels of file defragmentation or disk interleave adjustment. The latest version of the utility now features mouse support and significant performance enhancements, according to the company.

The three new utilities include PC Scan, a virus detection and elimination program; FAST!, a disk-caching program that speeds disk access; and Q-Menu, a menuing utility that provides access to the complete collection. Q-Menu is a multilevel menuing system. It has an on-line help system that lets you create customizable menus and submenus, letting you group similar applications together for fast access. It also provides password protection.

• List price: *The Q-DOS Collection*, \$179. Gazelle Systems Inc., 305 N. 500 West, Provo, UT 84601; 800-786-3278, 801-377-1288; fax, 801-373-6933.

Circle 414 on reader service card

HOT PROSPECT



Folio Views 3.0: Personal Electronic Publishing

Folio Corp. has unveiled its newest personal electronic publishing platform, Folio Views, Version 3.0. The system is built on the concept of an *infobase*: a dynamic (editable and annotatable in real time) single-file repository of information. Based on an open client server architecture, Folio Views 3.0 offers cross-platform compatibility and supports any combination of DOS, Windows, and Macintosh workstations. It lets multiple users update and annotate the infobase simultaneously. You can update the shared infobase locally or remotely, even when other users are accessing the same infobase file.

Folio Views 3.0 provides multimedia capabilities and supports embedded objects such as graphics, animation, audio, and video clips stored either in the infobase or externally to it. It has predesigned filters that facilitate the importing and exporting of information. It also offers a WYSIWYG interface. When you import a file into an infobase, it retains all its characteristics, such as fonts, styles, and formatting. The Folio system consists of Folio Views 3.0, the infobase creation and management tool, and Folio Annotator 3.0, a package that lets you view, search, and annotate Folio Views 3.0 infobases.

• List price: *Folio Views, Version 3.0*, \$495 per user; *Folio Annotator, Version 3.0*, \$195. Folio Corp., 2155 N. Freedom Blvd., #150, Provo, UT 84604; 801-375-3700; fax, 801-374-5753.

Circle 401 on reader service card

IMPROVED

Microsoft Rolls Out Windows and DOS Updates of FoxPro

Microsoft Corp. hasn't taken long to update its recently acquired FoxPro database. FoxPro for DOS, Version 2.5, and FoxPro for Windows, Version 2.5, offer significant performance improvements over FoxPro 2.0 cross-platform and forward and backward compatibility. FoxPro 2.5 will be available on DOS, Windows, Macintosh, and Unix platforms. Data and application code can be simultaneously shared in all the environments without any code modification. A new Cross-Platform Transporter feature automatically enhances the appearance of applications across platforms.

FoxPro for Windows, Version 2.5, is a full 32-bit application that takes advantage of Windows' Enhanced mode. It supports all standard Windows conventions and exploits the range of graphical user interface features, such as TrueType fonts, images, sound, and other multimedia objects. It supports DDE (Dynamic Data Exchange) and OLE (Object Linking and Embedding) as an OLE client. It also supports the ability to call Windows DLLs (dynamic link libraries).

FoxPro for DOS, Version 2.5, is available in both 16- and 32-bit versions (included in the same box). In the updated 32-bit version, the number of work areas has been increased to 225, and it now supports the DOS protected-mode interface so that it runs under Windows in 386 Enhanced mode in a DOS box.

• List price: *FoxPro for DOS, Version 2.5*, \$495; *FoxPro for Windows, Version 2.5*, \$495; upgrade from previous versions, \$99. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-429-9400, 206-882-8080.

Circle 406 on reader service card



FoxPro for Windows, Version 2.5.

NEW

Here & There Lets You Be in Two Places at the Same Time

Fifth Generation Systems has unveiled *Here & There*, Version 1.0, a new communications utility providing remote-control, file-transfer, and terminal emulation capabilities. The DOS-based package has bidirectional file-transfer capabilities, letting you send and receive data simultaneously and reducing data transmission time and phone charges.

Here & There allows you to transfer files in the background while running DOS applications in the foreground. A virtual drive lets you append the host PC's drives to the remote PC, including network drives. The virtual drive permits access to e-mail and a networked printer. It also lets you run any application on the host PC, access compatible files on the remote, and use DOS commands to manipulate files on either system.

Here & There minimizes screen redraws when running Windows remotely by letting you use Windows on the remote PC to access Windows files and applications on the host PC. The two-way remote-control feature lets you assume either the remote or host role without reconfiguration and without having to reinitiate the call.

• List price: *Here & There*, Version 1.0, \$149. **Fifth Generation Systems Inc.**, 10049 N. Reiger Rd., Baton Rouge, LA 70809; 800-873-4384, 504-291-7221.

Circle 402 on reader service card

NEW

NetWare Console Commander Loads NLMs

Frye Computer Systems is shipping *The Frye Utilities for Networks-NetWare Console Commander*, Version 1.0, allowing network administrators to schedule any NetWare 3.1+ console command to take place automatically at a specified time. Administrators specify the server, the commands, and the time, and the program executes them. It allows you to clear connections that interfere with backups, send messages, load and unload NLMs (NetWare Loadable Modules), run NCF files, set NetWare's settable parameters, and run any server-based programs.

NetWare Console Commander can be used to load NLMs only when needed, conserving server cache memory and optimizing the server configuration. Instead of leaving every program in memory constantly, you can load, run, and unload programs automatically, keeping them

BRIEFS

SOFTWARE

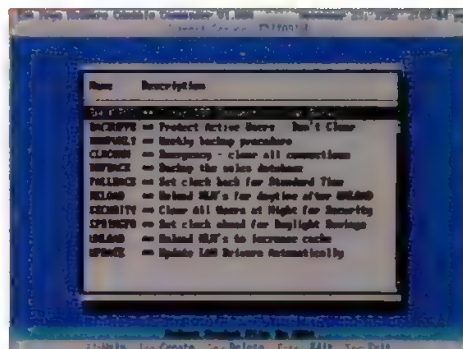
Afgo is shipping the *Discovery TrueType Font Pack* (\$79), a collection of 46 TrueType text and clip-art fonts and more than 1,000 clip-art images for Microsoft Windows 3.1. It also includes document templates for standard business forms, a Windows on-line font-support utility, and a *Discovery GuideBook* that shows you how to get the most out of the various type-usage tools featured in the *Discovery TrueType Pack*. 800-424-8973.

Award Software has unveiled a CMOS backup and restore utility that saves current CMOS data. The *Award CMOS Restore Utility* (\$19.95) creates a backup file of all current CMOS data. Standard CMOS data and extended CMOS data can be saved. The product also includes a low-level-formatting utility. 408-370-7979.

Corel Systems Corp. is shipping *CorelDRAW 2.5* for OS/2 2.0. The new 32-bit version of *CorelDRAW* is a native Presentation Manager application that has been rebuilt to take advantage of the OS/2 architecture. The package includes *CorelDRAW 2.5*, *CorelChart* and *CorelPhoto-Paint*, *CorelTrace*, *Mosaic*, and *WFBoss*. It also ships with a CD-ROM disk that has more than 12,000 clip-art symbols and images. 800-836-3729, 613-728-8200; fax, 613-728-9790.

DeltaPoint is shipping *Desktop Animator* for Windows, Version 1.0 (\$59.95), a utility that lets you animate icons and cursors and link sound effects to Windows events. *Desktop Animator* offers a set of painting tools for designing icons. Icons and cursors are animated using VCR-like controls to stack a series of images together like movie frames. 408-648-4000; fax, 408-648-4020.

Genus Microprogramming is now shipping the *GIF Toolkit* (\$249), which allows developers to incorporate .GIF images into programs. It contains more than 100 routines to display, save, scale, and manipulate .GIF images. It also includes Genus's *GX Kernel*, which provides VESA support; simplified Super VGA support; expanded, ex-



Console Commander lets you schedule commands.

in memory only when they are needed. *NetWare Console Commander* also increases security by clearing connections that remain open after normal business hours, closing potentially dangerous access routes. It also features a calendar that displays four consecutive months per screen.

• List price: *The Frye Utilities for Networks-NetWare Console Commander*, Version 1.0, \$395. **Frye Computer Systems Inc.**, 19 Temple Pl., Boston, MA 02111; 617-451-5400; fax, 617-451-6711; BBS, 617-426-1910.

Circle 403 on reader service card

NEW

NEC Unveils the UltraLite Autograph Pen Tablet

Just when you thought all the possible names for pen PCs had been exhausted, **NEC Technologies** proves that the well is not dry. The *UltraLite Autograph* pen tablet is a 3.89-pound unit that features Intel's 3.3-volt 20-MHz 486SL processor with 8K of cache. The unit ships in standard configuration with 4MB of RAM (expandable to 12MB), a 40MB hard disk, a 3.5-inch external floppy disk drive, a 9.4-inch transreflective display, an enhanced parallel port, and an external VGA port capable of displaying simultaneous video. It also offers two PCMCIA, Version II, slots and local-bus video—the first implementation of local-bus video on a portable platform.

The *UltraLite Autograph* is available preloaded with either Microsoft Windows for Pen Computing or GO Corp.'s *PenPoint*, and it offers an optional 83-key portable keyboard. It features programmable *HotZone* icons, similar in concept to keyboard function keys. By tapping the active *HotZone* icons with the pen, you can access various predefined functions, such as accessing the system setup menu, turning the backlighting on or off, and reversing the video display.

• List price: *UltraLite Autograph with Microsoft Windows for Pen Computing*, \$3,999; *UltraLite*



With our print server you'll use less paper.

Money may not be everything. But it sure is a good reason for you to buy our Pocket Ethernet Print Server. Not only is it faster than Intel, it's less expensive. It's also easier to work with. It plugs into the back of your printer with a minimum of effort. And it

can be easily connected anywhere on your network. In other words, you use less brainpower too. Give us a call at 1-800-874-7875 ext. 47B for the location of the MicroAge dealer nearest you. Because we would really hate to see you waste paper.

Xircom

From Your Friends In The Business...



Thank you for making 1992 the best year yet for everyone at Gateway 2000. Because of your belief in us, we captured an unprecedented five *Computer Shopper* 1992 Best Buy Awards including Best Overall Vendor.

And in *PC Computing's* 1992 MVP Awards, Gateway was honored with the MVP Desktop System Award for our 4DX2-66V system. Thank you *PC Computing*!

We're much obliged to *PC Magazine's* readers who gave us the best overall score in *PC Mag's* 1992 Service and Reliability Survey.

Our humble thanks to the readers of *PC World*. They honored us with two World Class Awards in 1992 – one for the Gateway 4DX-33 and another for Service and Support.

Our hats are off to *Compute* magazine for presenting us with 1992 Best Desktop Computer for the Gateway 4DX2-50.

We're thrilled that *Popular Science* magazine recognized the Gateway HandBook portable PC as one of 1992's "Best of What's New."

And thank you *BYTE* magazine for an Award of Distinction for the HandBook. *BYTE* readers also chose the Gateway 486DX as Desktop Computer of the Year.

Finally, we applaud all our loyal customers. Without your unwavering support throughout the years, Gateway couldn't have won these honors. We owe our success to you, and we'll be forever grateful. Here's to another great year in 1993!



**What Do You
Wish
For In A PC?**

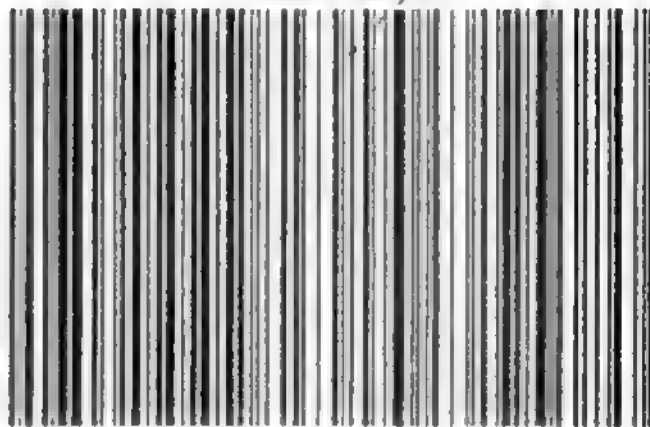




1. Follow instructions on the other side

Back

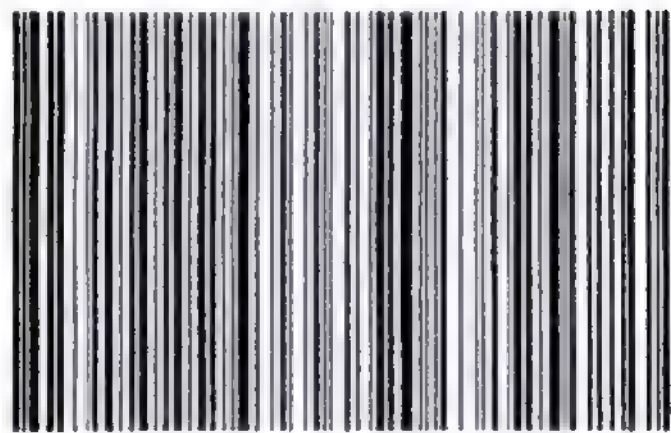
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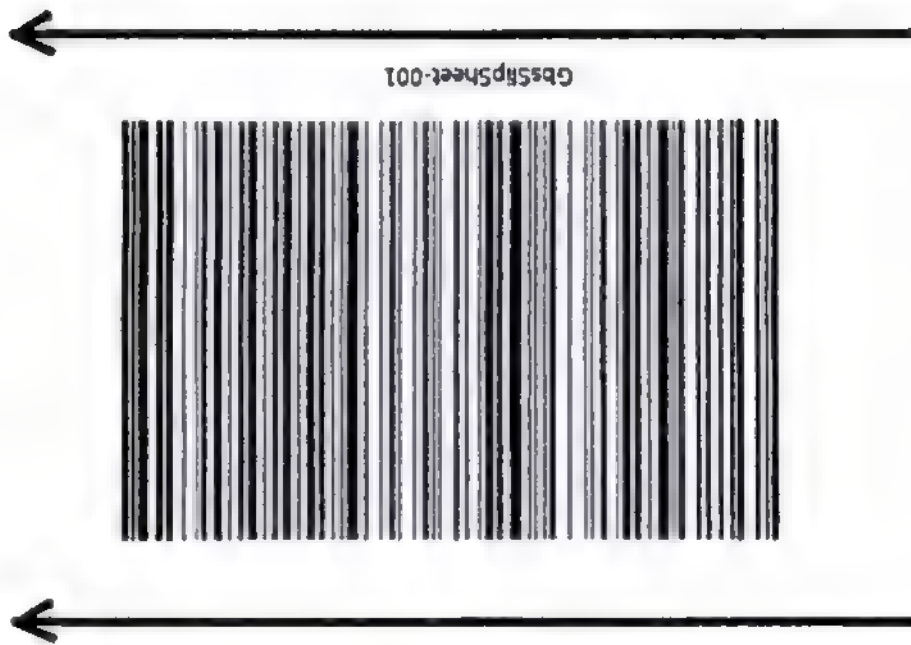
Inverted Back

1. Follow instructions on the other side

Folded edge of the page

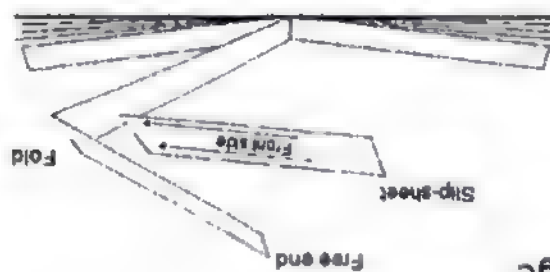


Gbs5lpSheet-001



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Your Wish Is Our Command!



A magical scene with a glowing genie lamp in the foreground, emitting a bright light. A large, billowing cloud of smoke or mist rises from the right side of the frame. The background is a warm, orange-hued landscape with scattered colorful gemstones or pebbles. The overall atmosphere is dreamlike and fantastical.

"I wish I could get a great PC
at a great price without sacrificing
performance and features."

"I wish I could be sure I'm
buying from a PC company that will
provide excellent service and support -
a company that will be around for me."

"I wish I could find the
combination of features I need in a
portable PC - at the right price."

Your wish is our command at

Gateway 2000! We can grant you the three most universal PC wishes in the wink of an eye. As a fringe benefit, we won't limit you to three wishes here. Most anything your heart desires in computers (sorry, we can't grant wishes for romance or riches), you can get from Gateway.

That's because we built our business by listening to our customers' wishes and doing everything in our power to make their dreams come true. At Gateway, we believe you should be able to *have it all*: the latest technology, glittering performance, quality construction, enchanting service and the fairest prices in the land. All this from a financially healthy company that won't run dry and leave you stranded in the desert.

You don't have to settle for less. With Gateway 2000, you can have it all. Draw up your wish list and give us a call. We'll make some truly magical values materialize for you.



Gateway Grants You The Most Wond

"I wish I could get a great PC at a great price without sacrificing performance and features." Your wish is our command!

You'll be spellbound by Gateway's ferociously competitive prices on systems



that are unequalled in powerful performance, impressive features and graceful integration of components. Other companies make the same claims, but the truth is revealed when readers and editors of the most popular PC magazines are asked which company delivers on its promises. Their overwhelming response is Gateway 2000.



"Gateway has gone far beyond conventional ideas of

price and performance. In doing so, it has created new rules that other PC makers will have to follow if they want to remain players."

- *PC Computing*, 1992 MVP Awards



"Gateway 2000 was the big 1992 Best Buy winner, sweeping not only the desktop awards as it did last year, but the newly expanded notebook categories as well ... Altogether, Gateway won five Best Buy awards this year, including Best Overall System Vendor ... It's no surprise that Gateway is consistently the people's choice when it comes to systems. Its formula for success is to sell fully configured PCs at aggressive, how-can-they-do-that prices, along with comprehensive service and technical support."

- *Computer Shopper*, 1992 Readers' Best Buy Awards

ous Value In The Land.



"Gateway not only captured the title for best desktop, it also got the nod for best service and support and ranked in the top five for portables, notebooks, most promising newcomer and best mail-order firm."

— *PC World*, 1992 Readers' Choice Awards



"I wish I could be sure I'm buying from a PC company that will provide excellent service and support — a company that will be around for me." Your wish is our command!

Twice in 1992, Gateway was honored for outstanding service. *PC World* readers ranked Gateway number one in service and support. And *PC Magazine* readers gave Gateway the best overall scores in the 1992 Service and Reliability Survey.

Just as important is our strength as a company. Warranties and assurances of lifetime technical support don't mean anything unless a company survives to honor them, which is a serious consideration in the shifting sands of today's PC marketplace.

Gateway is among the few financially robust companies in the industry. Our 1992 revenues exceeded \$1 billion and our earnings are among the strongest in the industry.

The company is virtually debt-free. At a time when other companies have been forced to lay off employees, we added 300 people to our staff.

You now have 1,800 friends in the business.

Rest assured Gateway is your oasis that will never leave you high and dry. We'll be here for you!



8 0 0 - 5 2 3 - 2 0 0 0

For The Nomad In You.

"I wish I could find the combination of features I need in a portable PC - at the right price." Your wish is our command!

No matter what you need in a portable, you'll find it in one of our Nomad models or in the Gateway HandBook.™ Gateway

customers selected Nomads as the winners in 386 and 486 notebook categories of *Computer Shopper's* 1992 Best Buy Awards.

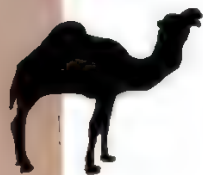
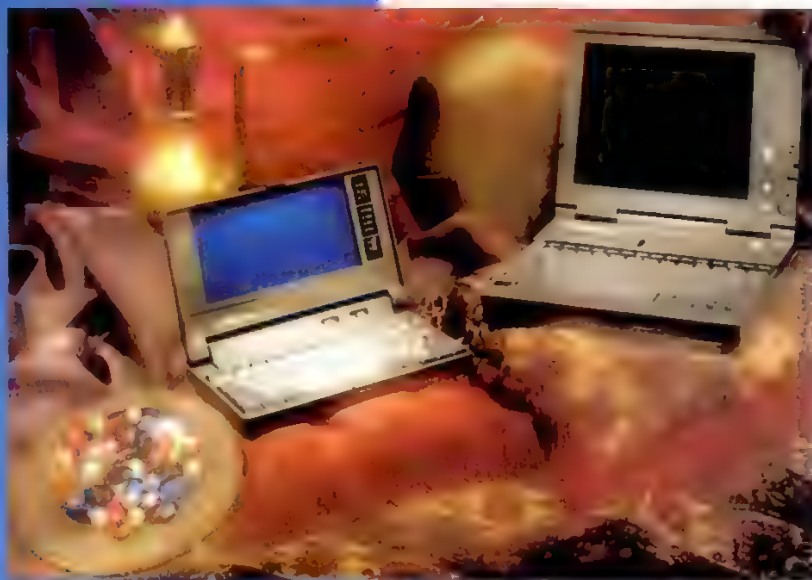
"There are faster laptops, there are cheaper laptops, there are color laptops, but there is no better laptop ... Weighing in at only 5.6 pounds, the Nomad combines the powerful punch of a 25MHz i486DX with a working battery life of more than six hours. At long last, we have a laptop

that can really go the distance when there's no power outlet in sight."

- *Computer Shopper*, 1992 Readers' Best Buy Awards

The Gateway 2000 HandBook is an enchanting, one-of-a-kind, real PC in miniature form! The HandBook, recognized by *Popular Science* magazine as one of the "Best of What's New" products of 1992, also received *BYTE* magazine's Award of Distinction.

PC Computing describes the HandBook as "an engineering marvel." *PC Week* agrees. "Gateway's HandBook is just about as small as a fully functional portable can be. Because the HandBook is powerful enough for most of my needs and fits comfortably in my briefcase, I now leave the computer bag at home."



Our Caravan Of Extras.

Software Selections

Your every software need is our command. With mini desktop, desktop and tower systems that include "choice of application software," select one of the following applications, all latest versions:

- Microsoft® Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf 92,®
CD-ROM Edition
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- The MS Entrepreneur Pack (Works,™
Publisher,™ Money,™ and games)
- Borland Paradox® or dBASE IV®
- The Windows Programmer Pack (MS
Quick C,™ Visual Basic and more)
- Upgrade to Microsoft Office™ for \$175

Free Utilities

Cool Tools for DOS, a diagnostic and utilities package, comes with all Gateway desktop systems and includes:

- QA Plus™ from Diagsoft™
- Central Point® Anti-Virus, RAM Boost,
Defrag and Emergency Disk

Microsoft Windows™ for Workgroups

Windows for Workgroups is ideal for e-mail, group scheduling and resource sharing, and includes an Ethernet adapter and software. Plus the hardware and software is factory-installed. You can see Windows for Workgroups running on Gateway systems in any of over 200 Egghead Software® stores in the U.S. Stop by for a demonstration!

■ \$159

Microsoft Windows Sound System™

This sound system designed especially for business use lets you speak to your PC for hands-free operation. It even reads numbers back to you for proofing. You can also embed audio messages in all your Windows OLE applications. Package includes soundboard, microphone, headset and software.

■ \$149

CD-ROM Kit

Includes interface card and everything you need to add CD-ROM to your PC. It's MPC-compliant and manufactured for us by Sony.®

■ \$225

The TelePath™ Fax/Modem

A 14,400bps modem, V.32bis, with 9,600bps fax capability. Includes WinFax Pro,™ Crosstalk™ for Windows, Qmodem™ and more.

■ \$195

CrystalScan™ 15-Inch Monitor

Non-interlaced 15-inch color monitor with flat, square screen – an upgrade option with the purchase of any Gateway 2000 desktop system.

■ \$100 (to upgrade from 14-inch 1024NI)

Panasonic Color-Capable Printer

Add color to your documents with this Panasonic KXP2123 24-pin dot matrix printer. Includes Adobe Type Manager.®

■ Printer, \$259; Color Option, \$50

Most Gateway peripherals are sold only with the purchase of a Gateway system.

For details on our complete line of components, peripherals and software, call direct to our special add-on components division at 800-252-3333.



 **GATEWAY2000**
8 0 0 - 5 2 3 - 2 0 0 0

Gateway 2000's Magical Values

DESKTOP SYSTEMS

3SX-25

- 25MHz 386SX Intel® Processor*
- 4MB RAM
- 5.25" & 3.5" Diskette Drives
- 80MB 17ms IDE Hard Drive
- Windows Accelerated Video with 1MB DRAM
- 14" Color CrystalScan™ 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard
- MS-DOS,® Windows™ & Mouse
- Cool Tools for DOS
- MS Works for Windows™ 2.0

\$1295

4SX-25

- 25MHz 486SX Intel Processor*
- 4MB RAM
- 5.25" & 3.5" Diskette Drives
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Windows Accelerated Video with 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- MS Works for Windows 2.0

\$1495

4SX-33

- 33MHz 486SX Intel Processor*
- 4MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Windows Accelerated Video with 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

\$1695

4DX-33

- 33MHz 486DX Intel Processor*
- 4MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 250MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Windows Accelerated Video with 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey™ Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

\$1995

4SX-33V

- 33MHz 486SX Intel Processor*
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- VESA Local Bus ATI Ultra Pro with 1MB VRAM
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

\$2195

4DX-33V

- 33MHz 486DX Intel Processor*
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 250MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- VESA Local Bus ATI Ultra Pro with 1MB VRAM
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

\$2495

4DX2-66V

- 66MHz 486DX2 Intel Processor*
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- VESA Local Bus ATI Ultra Pro with 1MB VRAM
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

\$2995

4DX2-66E

- 66MHz 486DX2 Intel Processor*
- 8MB RAM, 256K Cache
- 5.25" & 3.5" Diskette Drives
- 500MB 11ms SCSI Hard Drive
- 32-Bit EISA SCSI Controller
- Windows Accelerated Video with 1MB DRAM
- 14" Color CrystalScan 1024NI
- Tower Case
- 8 32-Bit EISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
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NEW

MicroTouch Ships Universal Snap-on Touch Screen

MicroTouch Systems is shipping the QuikPoint GX140, a plug-and-play universal touch-screen solution that snaps onto the front of any 13- or 14-inch monitor. Priced at \$695, the GX140's screen consists of an all-glass sensor that has a uniform alternating-current voltage field spread over its surface. When you make contact with the sensor, it "capacitively couples" to the voltage field, drawing the current to your finger. The resulting current flows are measured and digitized by the controller. The system has a resolution of 1,024 by 1,024 touch points and averages down the area of finger contact to a single point, giving you pixel-by-pixel control when touching the screen.

The GX140 installs quickly; you simply attach the touch screen to the front of the monitor. The unit controller card can be installed in a PC expansion slot or can reside in an external housing that connects to a serial port. According to MicroTouch Systems, the installation process, including the one-time calibration procedure, can be performed in minutes.

- List price: *QuikPoint GX140, \$695. MicroTouch Systems Inc., 55 Jospin Rd., Wilmington, MA 01887; 508-694-9900; fax, 508-694-9980.*

Circle 405 on reader service card

NEW

New Radius Pivot Monitor: More Colors, Better Refresh

The latest in **Radius's** line of Pivot monitors, the 15-inch PrecisionColor Pivot, is the first in its line to work with both IBM-compatible PCs and Macs. This rotating display, which lets you see a full-page view of your applications in either portrait or landscape mode, delivers more colors and higher refresh rates than previous Pivot monitors. It has a 75-Hz refresh rate at VGA and Super VGA resolutions and a 72-Hz refresh rate at 1,024-by-768. In addition, you can view up to 32,768 colors at 800-by-600 resolution.

A Radius SVGA MultiView interface is required to take advantage of the real-time pivoting capabilities of the PrecisionColor Pivot. You can rotate the display during a DOS or

BRIEFS

SOFTWARE

tended, conventional, and disk-based memory support; color conversion and dithering; and overlay support. 800-227-0918, 713-870-0737.

Mountain House Publishing's Idea Tree, Release 2.5 (\$69), is a brainstorming and idea-generating software package that stimulates the creative process by visually displaying any project or composition as an upside-down tree. The software builds "idea units" that branch out, clustering at lower levels and leading to specific ideas and methods of organization. 800-639-5044, 802-496-5000.

Parsons Technology is shipping Address Book for Windows, Version 1.0 (\$49). Address Book for Windows stores names, addresses, and telephone numbers and includes an auto-dialer feature. Each record has a memo field, and the program ships with a number of predefined records containing business and public institution contacts in 14 categories, including major airlines, chambers of commerce, hotels, and government agencies. 800-223-6925.

Peachtree Software is shipping a new add-on module for its Peachtree Complete Accounting software. Peachtree Contact & Account Manager (\$99) is a contact management software module that functions as a notepad, collections manager, text editor, and contact manager. Call schedules and mailing lists can be generated based on customer account aging. The product also generates mailing lists using a variety of user-defined criteria, such as sales representative IDs or ZIP codes. 800-247-3224.

Software Grove Corp. is shipping Software Grove Messages, Version 1.5 for Windows (\$69.95), an update to its package that assists in filling out the ever-present pink and blue phone-message forms. Enhancements to the new version include improved searching facilities and viewing of multiple messages. Messages can now be displayed either horizontally or vertically on-screen. A new option allows you to edit messages or password protect

Windows application without quitting and relaunching.

- List price: *PrecisionColor Pivot, \$1,149. Radius Inc., 1710 Fortune Dr., San Jose, CA 95131; 408-434-1010; fax, 408-434-0770.*

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IMPROVED

WEB: Peer-to-Peer Networking In Mixed Environments

A new version of **WEBCORP's** WEB Operating System for Microsoft Windows brings peer-to-peer networking to mixed DOS and Windows environments. WEB for Windows and DOS provides access to NetWare servers from DOS or Windows clients without requiring additional memory for shell and bridging software. It supports Novell's Open Device Interface (ODI) standard as well as connectivity to TCP/IP through the Packet Driver Interface.

WEBCORP's proprietary "burst mode" technology supports up to 127 packets per transaction and up to 16,384 bytes per packet, and on-line data compression provides increased throughput. The product's Station Manager interface can be loaded into upper memory and provides administrators with a variety of new utilities. WEB's e-mail facility, E-Note, is built into the DOS client version and is furnished as a module in the Windows client.

- List price: *WEB for Windows and DOS, \$99 (single user); \$449 (5 users). WEBCORP, 3000 Bridgeway, Sausalito, CA 94965; 415-331-1449; fax, 415-331-0911.*

Circle 408 on reader service card

NEW

BlackMirror: Continuous Hard Disk Backup

BlackCurreant Technology has introduced an automatic, continuous hard disk backup system called BlackMirror. The system operates transparently so that you don't have to stop working in order to perform a backup. When files are saved to the PC's internal drive, BlackMirror produces "mirror copies" so that the backup files are continuously up-to-date. The installation program lets you specify selected data for backup.

The system is housed in a 1.6- by 7.3- by 9.8-inch (HWD) casing that weighs 2.4 pounds. It connects to the PC through the parallel port and has built-in alarms to alert you to disconnection or malfunction. Data is stored on an internal hard disk rather than floppy disks or tapes. Capacities available include 80, 120, 160, and 240 compressed megabytes.

New & Improved

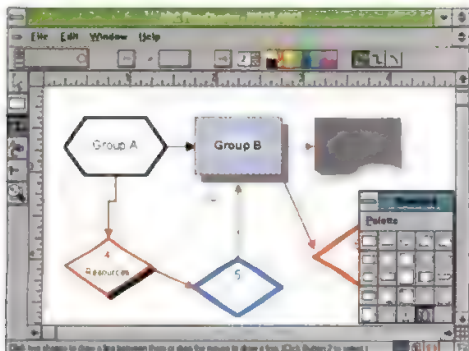
•List price: *BlackMirror*: 80MB, \$799; 120MB, \$899; 160MB, \$999; 240MB, \$1,499. *BlackCurrent Technology*, 575 Anton Blvd., #300, Costa Mesa, CA 92626; 714-432-6514; fax, 714-432-6551.

Circle 409 on reader service card

IMPROVED

Micrografx Updates Windows OrgChart and ABC FlowCharter

Micrografx is bringing updates of two Roykore products to market: *Windows OrgChart*, Version 2.0 (formerly *Instant ORGcharting!*), and *ABC FlowCharter*, Version 2.0. *Windows OrgChart* 2.0 is an organizational-charting software package that lets you create, update, and print organizational charts and tree diagrams. It offers a fit-to-page feature that allows the reduction of large charts to one page; a "best fit" specification automatically resizes all fonts. Other new features include the capability for comanagers or multiple top managers to be depicted at the same level, the abil-



ABC FlowCharter, Version 2.0.

ity to implement and save changes immediately, support for OLE (Object Linking and Embedding), and the importing of DOS files from Banner Blue Software's *Org Plus*.

ABC FlowCharter, Version 2.0, lets you construct charts that outline ideas, procedures, or policies. It offers automatic text handling and line routing, full on-screen color support, and multilevel charting capabilities. Its interface provides standard predefined shape palettes and context-sensitive help. A hint line lets you know what each tool represents, with editing buttons to support each selected tool. *ABC FlowCharter* contains new tool palettes for creating specialized diagrams.

•List price: *Windows OrgChart*, Version 2.0, \$149; upgrade from previous version, \$49.95; *ABC FlowCharter*, Version 2.0, \$495; upgrade from previous version, \$99.95. *Micrografx Inc.*, 1303 Arapaho, Richardson, TX 75081; 800-733-3729, 214-234-1769; fax, 214-234-2410.

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BRIEFS

SOFTWARE

and encrypt messages. 800-793-0040, 206-823-0833; fax, 206-823-1246.

Spreadware's pro forma (\$389) is a financial projections and statements add-on for Microsoft Excel 4.0. pro forma lets you design, generate, manipulate, and analyze pro forma (projected) financial statements. It can be used to forecast and evaluate a company's financial condition, estimate financial requirements, track cash flow sources, and perform "what-if" analyses. 619-347-2365; fax, 619-347-6045.

Step1 Systems is shipping *Stepway*, Version 1.0 (\$165), an integrated software package that has a suite of ten applications designed for home use. The applications include a word processor, a calendar/scheduler, a banner and sign maker, an address book, a home inventory database, a drawing utility, a recipe organizer, a greeting card and invitation maker, a to-do list, and a solitaire game. 800-435-7837, 404-992-1777; fax, 404-992-6999.

Duncan Clark is shipping *WinVelo*, Version 1.0 (\$129), an envelope and label printing software program for Windows. The program provides a font selection feature that lets you print on any part of the envelope or label in any font supported by the printer. *WinVelo* works with any HP LaserJet or compatible laser printer. 714-222-2833; fax, 714-474-0904.

Microcom is shipping *Relay Gold LAN 5.0* (\$825), its latest version of the PC-to-mainframe communication software. *Relay Gold LAN 5.0* supports asynchronous and synchronous modems, most protocol converters, 3270 emulation coaxial boards, direct Token Ring 802.2 TIC connections, and a wide range of gateways. 617-551-1000; fax, 617-551-1968.

RSoft is shipping DOS, Windows, and OS/2 versions (\$149 each) of *RPlot*, Version 2.1, the company's technical graphing package. *RPlot* 2.1 has a new integrated graphing environment, and an enhanced command-line program. 212-666-0959; fax, 212-666-3962.

NEW

MacroMechanic: Another Way to Speed Up Your Laser Printer

Synapsis Corp.'s *MacroMechanic*, a Windows-based utility that promises to enhance the performance of HP LaserJet and compatible printers, speeds up printing by loading documents, fonts, and graphics into the printer's memory for quick access and throughput.

The *Make Macro* function converts output files to printer macros that reside in printer memory. TIFF to Font and .PCX to Font utilities convert those graphic formats to downloadable font files, and the Font to Font ID utility converts bitmapped soft fonts to downloadable fonts. The program also includes an integrated file manager and document print controller. *MacroMechanic* directly supports applications such as Aldus PageMaker, Ami Pro, and WordPerfect for Windows. For other standalone and network apps, the program automatically creates printer activation files that control data flow to the printer.

•List price: *MacroMechanic*, \$199. *Synapsis Corp. Ltd.*, 5460 White Oak Ave., #A336, Encino, CA 91316; 818-906-1596; fax, 818-906-2070.

Circle 411 on reader service card

NEW

Saber Software Integrates Its LAN Utilities

In its new *Saber LAN Workstation*, **Saber Software Corp.** has combined the functionality of its network products, including *Saber Menu System* for DOS, *Saber Menu System* for Windows, and *Saber LAN Administration Architecture*. An integrated set of DOS and Windows utilities for administrators and end users, *Saber LAN Workstation's* tools aid in designing customized menus, tracking software licenses, and managing disk space. *Workstation* utilities simplify printing and file management and offer on-demand security.

Other utilities for administrators provide centralized .INI file management, automatic software and hardware inventories, and application metering with virus detection. *Saber LAN Workstation* is compatible with Artisoft's *LANtastic*, Banyan Systems' *VINES*, DEC *PathWORKS*, IBM *LAN Server*, Microsoft *LAN Manager*, and Novell's *NetWare*.

•List price: *Saber LAN Workstation*: single license, \$195; additional workstation license, \$79. *Saber Software Corp.*, P.O. Box 9088, Dallas, TX 75209; 214-361-8086; fax, 214-361-1882.

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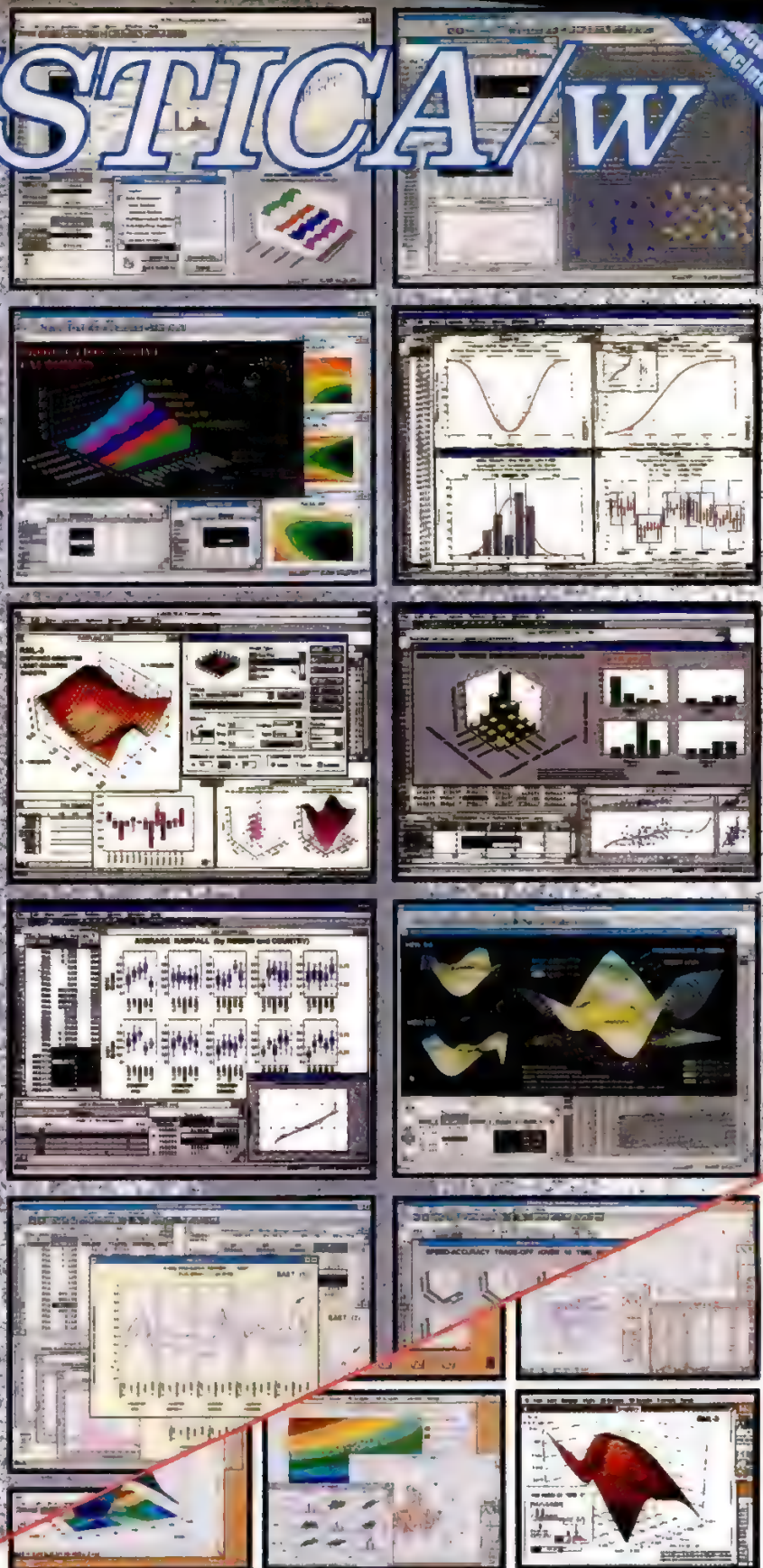


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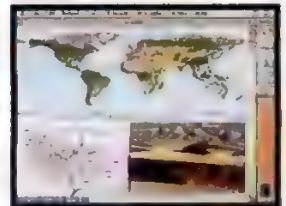
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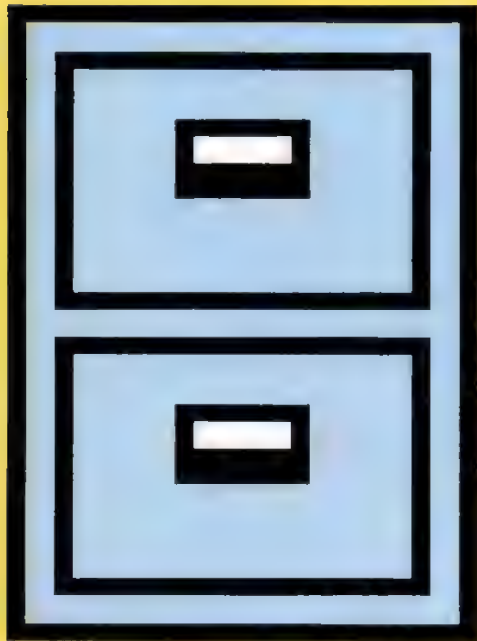


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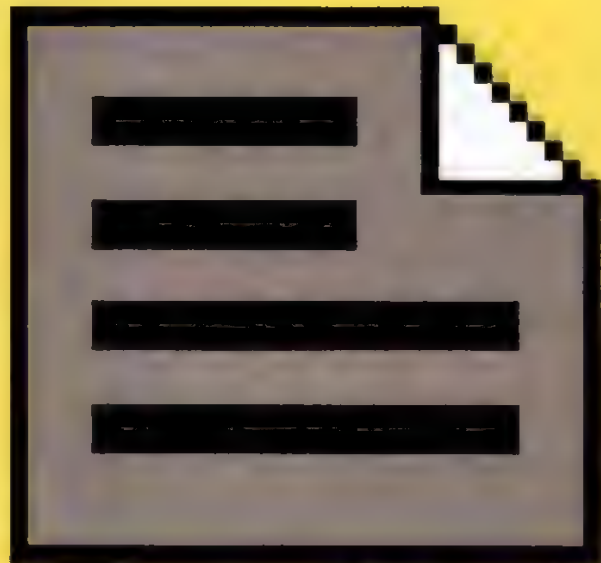
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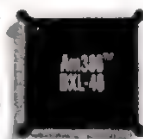
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1991



MX14
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1990



Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Image Lab Puts Graphics Theory to Work

BY LUISA SIMONE

Learning about computer graphics can be an expensive proposition. While several graphics programs can cost hundreds if not thousands of dollars, there's an inexpensive alternative. *Image Lab* by Tim Wegner comes with a disk of shareware programs that provide a hands-on introduction to the world of computer-generated images.

Image Lab doesn't cover the breadth of graphics applications but concentrates almost exclusively on raster-based images. It begins with simple gray scales and progresses to spectacular full-color pictures.

Wegner isn't afraid to tackle the complex technology behind the pretty pictures. While many graphics books oversimplify,

Wegner is unhurried and insightful. You'll learn why resolution must always be measured in terms of both pixel count and bit depth, and discover how the new high-color (15-bit) adapters compare with standard 8-bit or high-end 24-bit hardware. He also explains truly advanced subjects, such as the iterative mathematical formulas that generate beguiling fractal images and the inner-workings of a ray tracing program.

Of course, you are expected to install the five shareware programs and put the theories you've learned into practice. The programs range from simple file viewers and conversion utilities to programs that apply special-effect filters and render photo-realistic objects.

There's no denying the power of these programs, but

shareware products lack the amenities business users expect. Be prepared to work with command-line parameters, batch files, and text-based data files. If there's a flaw with *Image Lab*, it's that Wegner doesn't explain the technological advances or conveniences of commercial software. This shortsighted approach might lead novices to believe that these shareware programs are state-of-the-art—a grave misconception.

Image Lab is targeted at the computer enthusiast who has a deep interest in pixel-based pictures. The author's clear explanations, the power of the shareware programs, and the beauty of the sample images all add up to a bull's-eye.

• *Image Lab*, by Tim Wegner, \$39.95, Waite Group Press, 200 Tamal Plaza, Corte Madera, CA 94925; 800-368-9369. ISBN: 1-878739-11-5.

Circle 456 on reader service card



■ The Lowdown on High-End

Here's a real find for anyone who needs to know what color is and how to get it right on both screen and paper. *The Desktop Color Book* (Verbum Books, 619-944-9977), from the editors of *Verbum* magazine, is a small, 63-page book lavishly illustrated with hundreds of detailed examples that explain everything from additive and subtractive color models to resolution terminology and vector versus raster drawing. The plain-English presentation deals with all the questions that arise when you read about high-end image editing, illustration, and drawing software, as well as color scanners and printers.

Products from Kodak, Pantone, QMS, and Radius get

little plugs (they helped develop the book), but that doesn't get in the way of the clear presentation. At \$14.95, the slim book may seem a bit pricey, but it's the best illustrated glossary for the confusing world of color that we've seen.—Don Willmott



Windows Interface Design

BY NEIL RUBENKING

Every Windows programmer should study *The Windows Interface, An Application Design Guide*, for in it are recommendations from programmers at Microsoft and other developers on every detail of interface design. The guide codifies the rules for consistency, which, in turn, can save training time, boost productivity, and promote user confidence.

Think you already know the interface inside and out? Then these questions won't stump you: How many items should be visible in a list box? When should a Cancel button's title change to Close? When should the word *error* be used in an error message? You'll find guidelines for these and other design issues in *The Windows Interface*.



Since even well-informed programmers may have no training in interface

design, the book starts with these principles: The user should be in control, the program should keep the user informed, and the interface should be consistent and clear. It details specifications for selection, navigation, feedback, menus, windows, dialog boxes, object linking and embedding, and the pen interface.

The accompanying software includes a visual presentation of interface elements and a dynamic link library of cursors

and buttons.

The specifications here are strictly guidelines and suggestions, not requirements. However, when a programmer deviates from the standard interface, it should be by design, not by accident.

• *The Windows Interface, An Application Design Guide*, by Microsoft Corp., \$39.95, One Microsoft Way, Redmond, WA 98052-6399; 800-677-7377. ISBN: 1-55615-439-9.

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THE KITCHEN SINK IS

Our T4500C features an LCD TFT active matrix color screen that can display a kaleidoscope of 256 simultaneous colors from a palette of 185,193. Our T4500 offers a large, bright, easy-to-read 9.5" VGA display with 640 x 480 resolution and 17:1 contrast ratio.

A 150-pin expansion port lets you attach a SCSI adapter to the notebook. Or lets you attach the notebook to our Desk Station IV, providing true desktop capabilities in your office.

System control hotkeys save time by allowing you to quickly change your display setting, power management, security status, etc., without having to call up menus.

A generous 4MB RAM standard, expandable to 20MB.

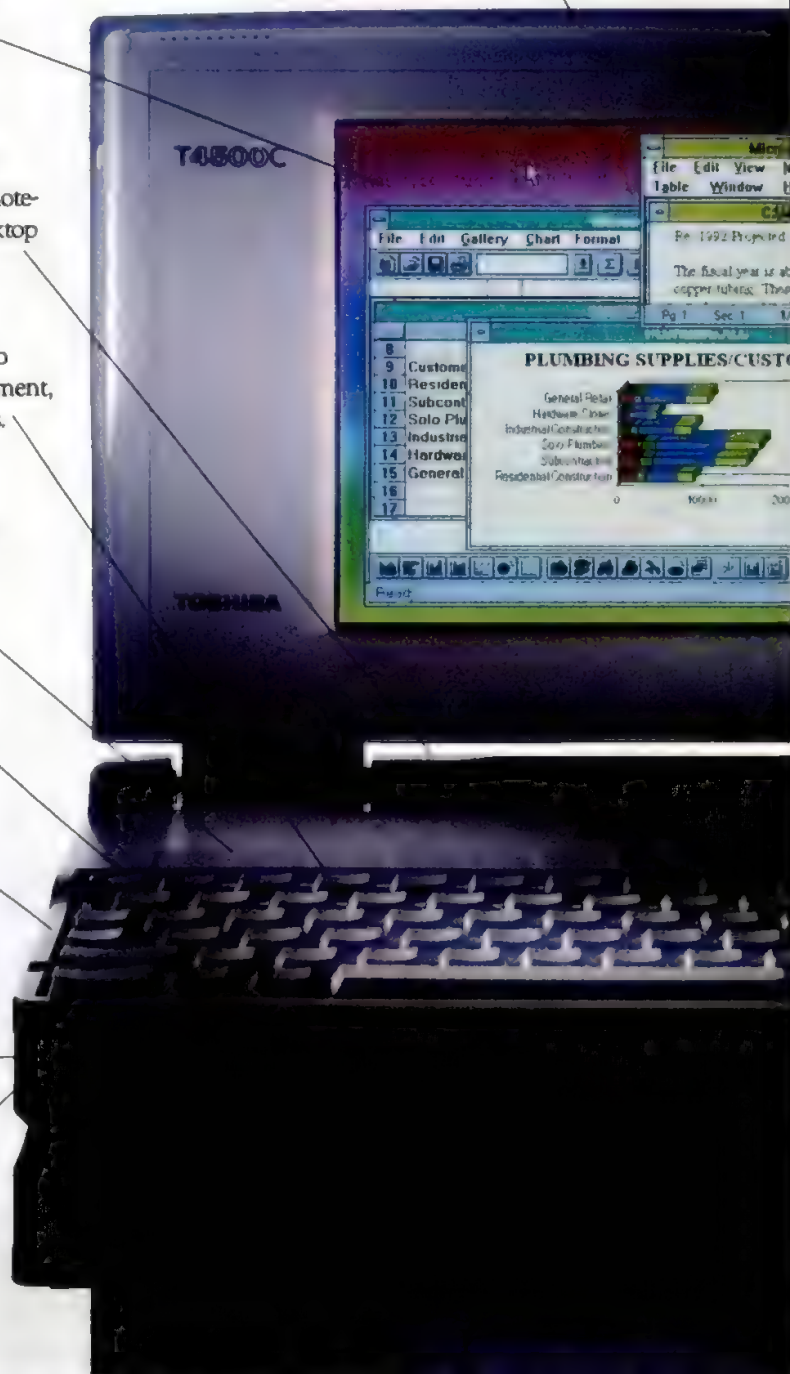
Our award-winning keyboard features standard-sized keys and key spacing.

The T4500 series' advanced 20MHz i486™ SX processor makes any 386 seem like a tortoise. In fact, tests reveal it's up to two and a half times faster than many 386-based notebooks.

The T4500C comes with a 120MB hard drive and our T4500 comes with a choice of an 80MB or 120MB hard drive.

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Both fit into half of a briefcase.

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AutoResume lets you start where you left off without rebooting and automatically saves your material when you turn the power off.

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Featuring AutoResume, AutoSave, Advanced Power Management, and CPU Sleep Mode, our MaxTime™ power management system helps you get the maximum out of every battery charge.

Quickread LCD status icons allow you to check a host of functions (including remaining battery time, keyboard status, and power-saving mode) at a glance.

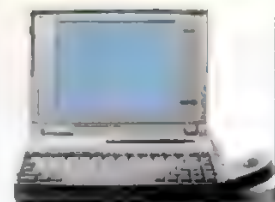


An industry-standard PCMCIA 2.0 slot accepts removable hard drives, data/fax modems, network adapters, and other expansion options.

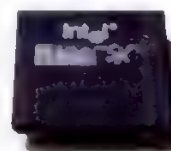
The BallPoint™ mouse connects directly to the computer through a unique "one touch" QuickPort®, so there's no cord to get in your way.

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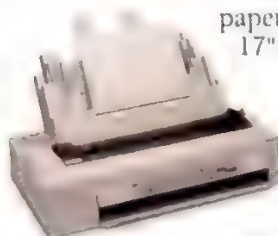


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CIRCLE 237 ON READER SERVICE CARD

Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

Give Your DOS Programs a Face-Lift with object-Menu

BY BEN MYERS

Does the list of enhancements for your DOS-based programs include a graphical user interface? If so, you can give them the face-lift they need with object-Menu. Island Systems' object-Menu is a C++ class library whose programs are conceptually similar to the Microsoft Windows user interface and to Borland's character-based Turbo Vision for DOS: They are event-driven, responding to user-provoked events such as mouse clicks and keystrokes. In addition, the class library includes a host of predefined objects such as menus, edit controls, list boxes, dialog boxes, icons, icon bars, scroll bars, sliders, buttons, and many others. Like any well-behaved C++ objects, they can serve as the basis for deriving new objects, which may inherit, change, or add to existing properties.

object-Menu is nondenominational in its support of graphics function libraries. You may use the Borland Graphical Interface (BGI) built into Borland C++ 3.1, the Microsoft graphics library that is part of Microsoft C/C++ 7.0, MetaGraphics' MetaWindow, Genus Microsystems' GX Graphics, or Media Cybernetics' HALO Professional. object-Menu inherits the characteristics of the underlying graphics subsystem that you use, particularly the display resolutions and fonts. In all other respects, the look and

feel of an object-Menu program remains consistent when compiled with the various supported graphics libraries.

For example, Version 1.0 of object-Menu was developed to operate with Microsoft C 6.0. Higher-resolution VESA-compliant graphics modes are supported by Microsoft C/C++ 7.0, released later. object-Menu programs compiled originally with C 6.0 can use the VESA (Video Electronics Standards Association) graphics modes with only a little redesign that takes into account the relative differences in screen sizes. Similarly, you can easily incorporate support for BGI drivers developed by third parties.

At first glance, the executable programs compiled with object-Menu (300K or larger) may seem big. But considering it incorporates full GUI functionality, this really isn't surprising.

The object-Menu reference manual is packed with useful information, but it's hard to find some of the key information using the index. It's best to read the entire manual before starting to use object-Menu. The documentation also has a few gaps. Certain fundamental terms and concepts are not well explained, and there's no on-line help for the object-Menu class library objects and methods.

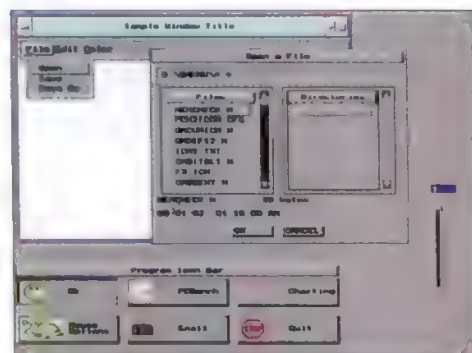
object-Menu comes with over 100 sample programs. But there's no example that implements a simple yet useful application to show you how the

parts of object-Menu work together.

object-Menu programs use either the Borland or the Microsoft overlay scheme to maximize the amount of memory available for your application. A sample DOS real-mode program compiled with the default overlay parameters still had 320K of memory left over to use for additional processing logic. If an application requires still more memory, object-Menu works with the Phar Lap DOS extenders to take advantage of available extended memory above 1MB.

There are 20 different icons supplied with the package. object-Menu uses its own compressed .ICN icon file format, and supplies a utility to convert standard .PCX files to .ICN format. You can make up your own icons with PC PaintBrush or another PCX graphics editor, then convert them into .ICN format. Be aware, however, that object-Menu uses a default color palette for each mode it supports. It applies that palette to the entire application, disregarding any palette information in a .PCX file. Therefore, make sure that your PCX editor uses the palette for the color mode in which the icon will be used. Otherwise you will get some surprising color combinations.

If you plan to develop software for users who have different graphics adapters, you must provide icons for each of the supported color depths: 2-color monochrome, 16 colors, or 256 colors. Then your program must include logic to manage



A sample object-Menu program compiled with Borland C++ 3.1 sports a menu bar, a drop-down menu, a file selection dialog box, an icon bar, and a slider.

the different icons. Microsoft Windows, IBM OS/2, and other graphics environments build icon and font support directly into the environment rather than the application. object-Menu provides an icon library and a utility to manage it so you can distribute one file of icons rather than many icon files with your application.

Island Systems is in the final stages of testing Version 2.0 of object-Menu, which is also expected to support dual development for DOS and Windows using the same source programs. By the time you read this article, Version 2.0 should be shipping, as well as a needed screen-painter utility that generates C++ object-Menu programs.

While object-Menu requires an investment of time to read documentation and pore over examples, it does pay off. You can create attractive DOS GUI software applications with object-Menu, a refreshing departure from character mode. □

• **object-Menu, Version 1.0**
List Price: \$369; with source code, \$898. Requires: Microsoft C/C++ 7.0 or Borland C++ 3.1. Island Systems, 7 Mountain Rd., Burlington, MA 01803; 617-273-0421.

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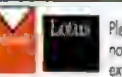


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Michael J. Miller

Improv: A Better Spreadsheet

Sometimes the rows and columns of a spreadsheet can start to look like prison bars. If you were freed from their confines, what would you do? Slice up your data one way, then another? Maybe do some quick comparisons . . . without wrestling the

application to the ground?

But wait. You're still trapped inside your old spreadsheet. You can't do all that, since the traditional spreadsheet model imposes some strict rules, turning what should be simple analysis into overly complicated multiple worksheets. And big headaches.

Lotus's Improv 2.0 for Windows changes the idea of what a spreadsheet is in a couple of fundamental ways. It requires unlearning some old conventions and works best if you can think ahead and understand the elements of your spreadsheet before you build it. Improv will appeal to people who have well-defined models that expand and change but retain their underlying structure.

THE TWELFTH DIMENSION

If you've heard of Improv (a version has been available for the NeXT since 1991), you may have heard that it's a multidimensional spreadsheet: 12 dimensions, to be specific. Sounds complicated.

Multidimensional can be a tricky word to pin down. It brings to mind the three basic physical dimensions, then time, and then . . . what? Improv isn't about multidimensionality in the strict sense. It's about modeling data stored in multiple categories, which enables you to view the numbers from multiple perspectives without reconstructing the spreadsheet or building a new one. These categories might be quarters, years, regions, products, and sales. Each category is then divided into items: Regions might be divided into North America, Europe, Asia, and Africa. You can have up to 12 categories or *dimensions* of data per model.

The real advantage of categories is in the way you can move them around to view different

cross-sections of data instantly. You could easily display a model that shows regional sales broken down by product, and then, with a mouse click, show product sales by region broken down by year. Compared with traditional spreadsheets, Improv takes a lot less work to reveal a whole lot more information.

Improv's emphasis on categories is its most important aspect, and its most challenging. To set up a spreadsheet, you first create the categories and the items, then add your data. This two-step procedure forces you to think ahead and to understand what you're trying to accomplish, unlike the ad hoc approach people take with traditional spreadsheets.

Then, by rearranging the categories, by hiding and showing different items in your model, and by expanding and collapsing groups, you can create multiple views or different ways of looking at your data. For instance, you might have one view for entering numbers, another for presenting the numbers, and another for analysis. Improv can save up to 16 views and easily switch among them.

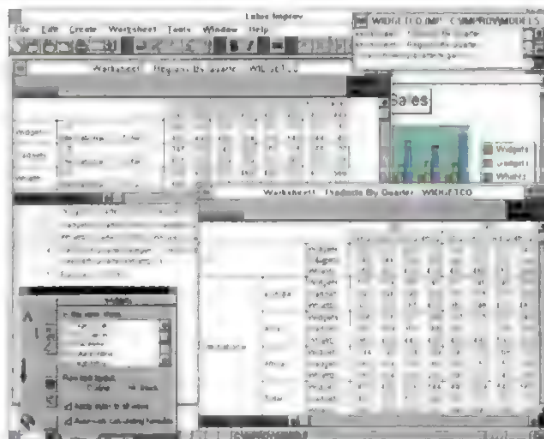
Improv is also malleable. You can group items together and easily add a group summary, an average, or other calculation. The outlining features then let you

collapse and expand the groups.

SPEAKING IN ENGLISH

Another big departure from the traditional spreadsheet is Improv's use of Dynamic General Formulas. Instead of placing formulas in individual cells, you place all of your formulas in a separate formula window. And instead of referring to cell labels, you refer to the name of the item: Instead of writing "+B4*C4," you write "Cost of Goods Sold = Unit Sales * Unit Costs."

Because Improv works on sets of numbers instead



Lotus has deconstructed the traditional spreadsheet and created a multidimensional number cruncher.

Michael J. Miller

of individual cells, you're less likely to make errors. For instance, the Cost of Goods Sold calculation will automatically apply to all of the COGS entries, so you don't have to worry about copying a formula to the proper range.

Since you're likely to have formulas that overlap each other (a formula that totals the cost of goods for multiple products will overlap with the basic COGS formula), Improv makes overlaps easy to deal with. As you create formulas, Improv places them in the formula sheet, and it calculates formulas in the order they appear on that sheet. The program alerts you if one formula overlaps another so you can change the order of the formulas. And when you select a formula, the model immediately highlights the cells it affects to help you track the logic of your model and reduce spreadsheet errors.

Improv also has several little conveniences that make formula writing easier. There's a pop-up list of functions and features that lets you easily add periodic qualifiers to your formulas, such as making each

quarter's results 2 percent higher than those of the previous quarter.

This general approach to formulas has many advantages. Because formulas appear on one sheet and use item names instead of cell references, your model is easier to follow, maintain, and distribute. Although traditional spreadsheets can use range names to create formulas, the formulas still stay within a cell. Improv's approach is easier.

Improv also has a fairly strong charting engine through a separate but linked application called Lotus Chart, which Lotus expects to include in future versions of many of its products.

One nice addition that I expect will get plenty of attention is the Info Box: A pop-up box that lets you easily change details such as colors and fonts of whatever part of the model you select. Even better, it takes up very little screen real estate, but can be expanded to include all sorts of options.

Compared with the NeXT version of Improv, the Windows version is more robust, has better programming features, and is easier to use. The Windows version adds real programming features through LotusScript, a new BASIC-like scripting language Lotus plans to offer across its

products. The Windows version also has simpler menus and uses Lotus's Windows-standard SmartIcons and status bar. It can import .WK1, .WK3, and .XLS (only Version 4.0) files, but be prepared to spend a lot of time making modifications if you want to use your old models in Improv.

THE REAL PIONEERS

Not all of Improv's ideas are unique. Years ago, PFS:Plan used set-oriented formulas, and Javelin and TM/1 have offered multiple dimensions for years. Computer Associates' CA-Compete also has 12 dimensions in a spreadsheetlike display, and the company is working on a new version that combines these features with traditional spreadsheet features. So far, nothing I've seen is as revolutionary and accessible as Improv.

My guess is that most people who use Improv will continue to use traditional spreadsheets. People are comfortable with them, and they're much easier for ad hoc work, such as simply adding together cells from different places on the sheet.

Improv redefines the spreadsheet as we know it, but for now, it will coexist with the tried and true. It requires a different way of looking at spreadsheets, but I think users will like what they see. □

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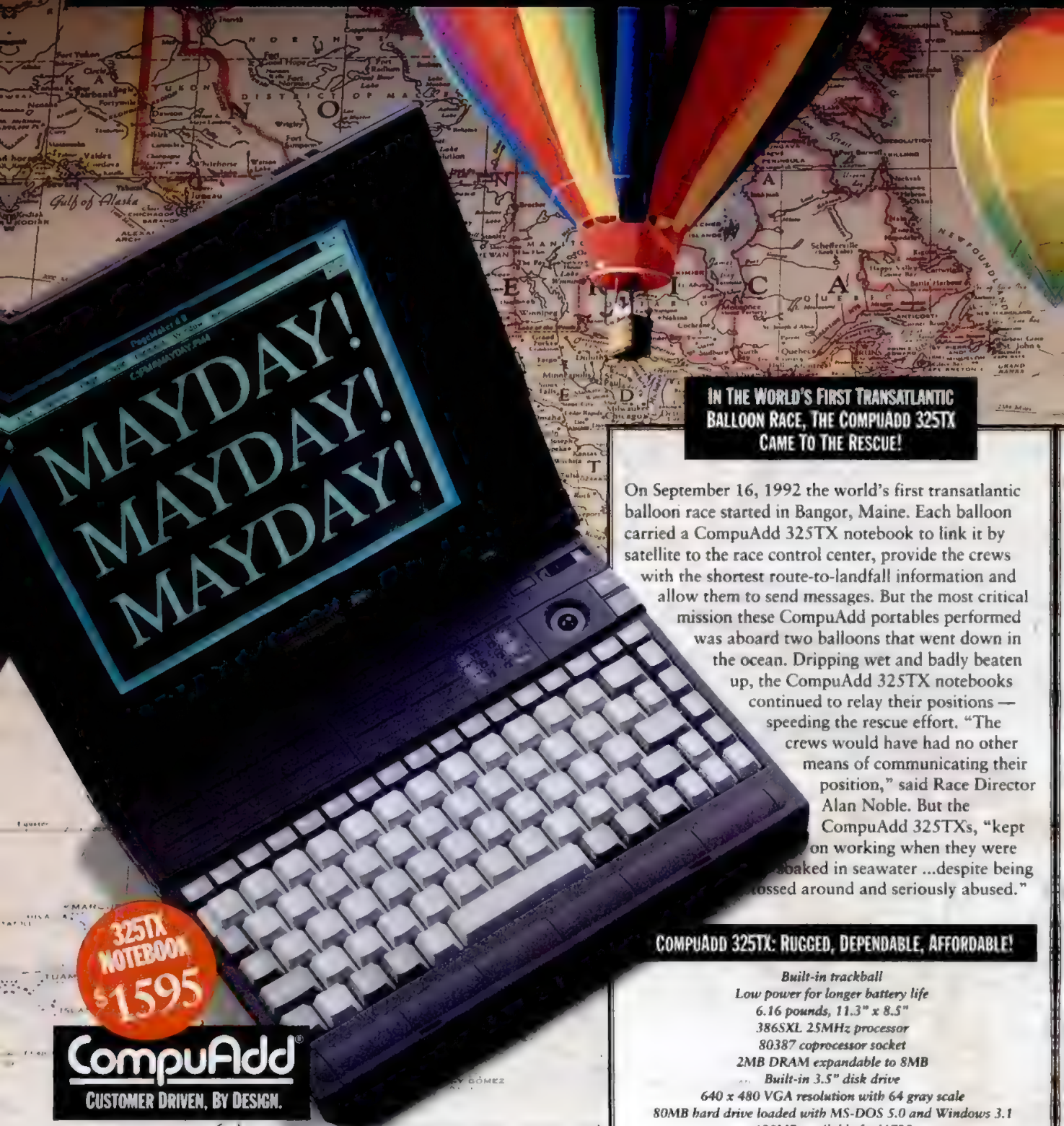
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CIRCLE 282 ON READER SERVICE CARD



Bill Machrone

My Computer's Turning Green!

There's an environmental disaster area sitting on your desk. No, not the pile of papers, memos, and periodicals you haven't filed. Not that styrofoam coffee cup. Your computer. A harmless-looking beige box and monitor seem the very

model of modernity: super-efficient microprocessors and integrated circuits performing fantastic feats of computing while sipping tiny amounts of electricity.

Compared to the mainframe monsters that they're replacing, desktop systems are a blessing. They are quite happy without having special wiring and supplemental air conditioning; never mind the priesthood and acolytes to make them work. The problem is that there were a couple of thousand of those old mainframes, and most of them are still out there, somewhere. They have been joined by 60 or 80 million personal computers in the U.S. alone. Think of each PC and each monitor as a hundred-watt light bulb, and then you begin to see the problem.

You probably don't walk into a room, flip on a 200-watt light, then leave immediately. Yet that's what most of us do with our computers. We power up, log on to the network, then go get a cup of coffee. Many of us spend the better part of the day out of our offices on the endless trail of meetings, while our PCs keep things warm for us. We stop back in the office to catch up on a little e-mail, then off we go again. Even while we're in our offices, we may spend as little as 20 percent of our time using the computer. It's great to have our faithful electronic servants always ready to do our bidding, but those 80 million personal slaves are sucking down 16 gigawatts of power nationwide.

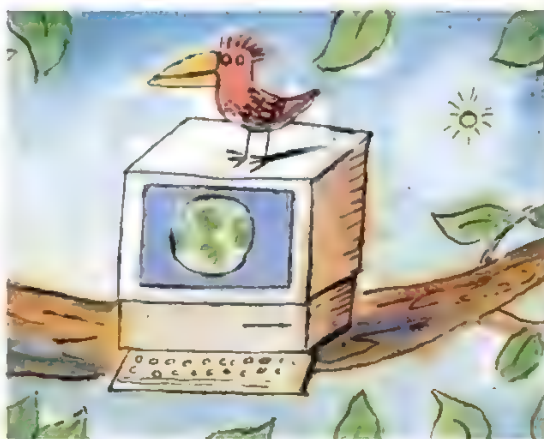
That's enough power to supply all of Saudi Arabia's electrical needs. (Think of all that air conditioning!) It's more than Switzerland or Austria can even generate. It's more than it needs to be.

The great thing about electricity is that there's virtually no local impact. Somewhere on the other end of the wire, however,

there's a tanker full of oil or natural gas, or a trainload of coal, feeding the hungry maw of the power plant; taxing our natural resources; generating acid rain; warming our rivers; borrowing against future generations' health, comfort, and prosperity.

There's a local impact compounding the problem, too: heat. It takes even more electricity to remove excess heat from our offices. You've been in empty conference rooms and auditoriums that seemed a little chilly. Then everyone files in, and the room quickly warms up. Each person puts out roughly as much heat as a 100-watt bulb. So each computer is an extra person or two in the room. It's difficult to measure the actual cooling load and the attendant costs in air conditioning capacity, but they're there. Most manufacturers who burn in their computers don't bother with supplemental heaters in order to raise the temperature. They just put a bunch of machines in a room and close the door.

Worse, the majority of today's offices are not wired to handle the load. Electrical systems that were designed to handle a desk lamp and a typewriter come perilously close to melting down when multiple laser printers suddenly show up on the same circuit.



Now that PCs have changed the world, it's time for a little environmental awareness.

FEELING GUILTY?

None of this is your fault. The systems are designed for you to turn them on and leave them on. Manufacturers aren't really to blame, either. Back when the design rules were laid down, no one knew that there would be a hundred million of these things worldwide.

Now we know enough to solve the problems. Laptop computers do power management as a matter of course. It would be a simple matter to apply the same technology to the desktop, but the problem is never that simple. For

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Bill Machrone

one thing, laptop systems are highly integrated. The power conservation circuits control the screen as well as the disk and processor. In desktop systems, the monitor and system are independent. The monitor displays what the computer sends. If you cut off the video signal, all you have is a blank screen—there's no power savings. Worse, some monitors free-oscillate, making annoying high-pitched sounds in the absence of a video signal. Monitors are getting intelligent, but they still aren't smart enough to know when you're not looking at them. It's possible to design a monitor that puts itself into a power-down state whenever the computer removes the video signal. We'll see such monitors in the coming months.

If the Environmental Protection Agency has its way, we'll see a lot more than just smart monitors. The EPA launched the Energy Star program last summer, intending that vendors start shipping products this summer. Energy Star's goal is to prevent pollution before it starts by lowering power consumption through intelligent design. Leading companies have already signed up: Apple, IBM, Compaq, Acer, Digital, Hewlett-Packard, AST, NEC, Zenith Data Systems, Nanao, NCR, and others. It will also include industry allies (Intel was first among them) and utility allies. Intel's role is visible in its redefinition of the 486 product line, where virtually all 486 chips will have low-power capabilities. AMD is doing the same and has taken an early lead in low-voltage, low-power devices.

Energy Star's initial focus will be on system units and monitors. The goal is to produce systems that consume 30 watts or less in low-power states. Given existing laptop technology, the potential exists to cut consumption to near zero in the idle state.

Monitors are a tougher challenge than computers. You aren't likely to wait patiently for the filament in the CRT to warm up before you can resume work on your screen. Also, many screens look washed out before the CRTs are fully warmed, a process that may take 15 minutes or more. Perhaps the new generation of super-insulators can be applied to the problem. Then again, if we become sufficiently energy conscious, we may hurry the progress of color LCD panels to the desktop.

These are important steps in the evolution of the personal computer. There's no coal pall over London. Pittsburgh is clean. Yet we have a worldwide energy to-do list. Be part of the solution—an energy star. □

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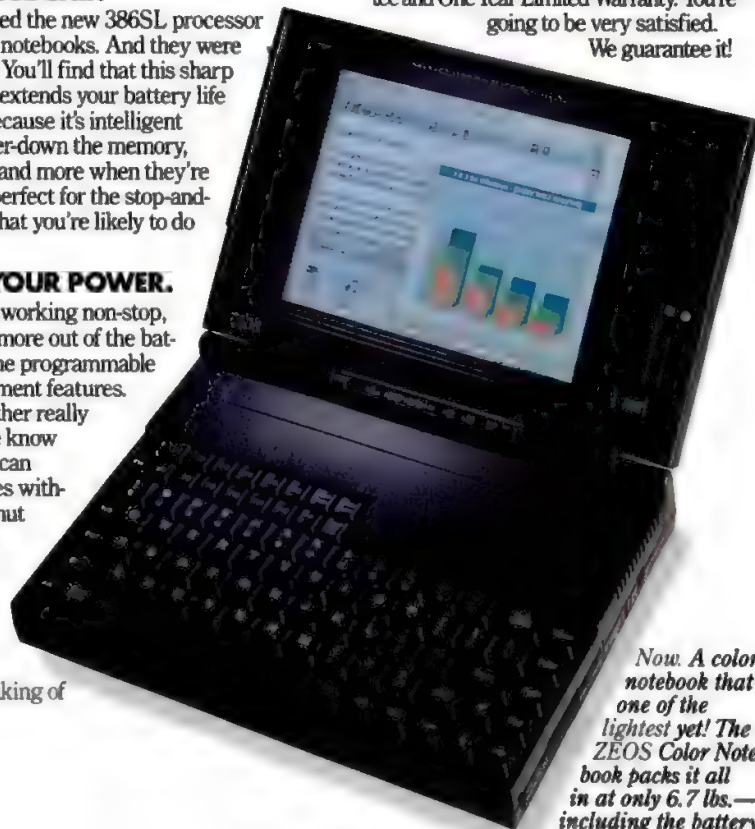
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CIRCLE 038 ON READER SERVICE CARD



John C. Dvorak

Dvorak's Annual Comdex Analysis

So, I finally went over my 1992 Comdex catalog to look for industry trends. Every year, I like to evaluate the Comdex Program & Exhibits Guide and compare its contents with those of the previous year. The 1992 guide showed

remarkable growth and new directions. Last year was apparently the lull year, as the page count dropped to 622 pages from the record of 654 pages set in 1990. Well, the old record was blown away with a 724-page guide for 1992. This is interesting because the last time the book size shrunk was in 1983, and that marked a two-year downturn. It appears this time that either the industry downturn lasted only one year or 1992 was a fluke.

Let's look at some of the product trends we can extrapolate from the catalog.

Most significant this time around was the inclusion of a couple of big new categories. The first is Imaging. This is not a subcategory under something else. It's a whole new major category with a slew of subcategories under it. This new category with its hundreds of vendors means graphics is going to be part of the everyday PC.

This was confirmed in the Multimedia category, where listings also grew. The A/V Board listing grew from 32 vendors in 1991 to 80 in 1992. The new CD-I Vendor listing appeared, with 25 makers. Film-Output Devices went from 6 entries to 27! Voice I/O Related to Multimedia jumped from 11 to 47. Folks, there's going to be a lot of light and sound coming at you in the years ahead. The Multimedia category wasn't even in the catalog two years ago.

The show also gained a new dimension by swallowing its pride and appealing to OEMs with a major new category all their own. This shocks me, since the show is supposed to be a computer dealers' show: Comdex = Computer Dealers' Exposition. Those days are over. Comdex has finally admitted that it's a hybrid of some sort. It sells parts!

Most of the traditional categories either expanded or remained stable. Last year's surprise

category, Home Computing, drew even more vendors this year, jumping from 19 to 29. This category was nonexistent in 1990.

If there was another emerging theme, it's maturity. Ergonomics was up from 35 to 50 exhibitors. People need to be comfy. People also need security: Backup was up from 25 to 36. More significant was the increase in exhibitors of power protection, which went from 2 to 42. Exhibitors of network protocol converters went from 48 to 11—another sign of maturity.

The big categories were still big, but shrank a bit. The number of companies that categorized themselves as making graphics boards (not including multimedia-specific boards) went from 87 to 81: not an important drop. The big category of Personal Computers dropped from 196 to 149. I guess the price wars did have an effect! Ever-shrinking categories such as Multiuser Computers contracted even further, hitting a new low of 27. There were 61 of them listed in 1991.

A few minitrends I spotted that might be of interest were an increase from 12 to 23 for Forms Processing exhibitors. Music jumped from 11 to 23. Office Automation made a downturn and fell from 60 to 49.

Pen-Based Computing became a new category, with 20 entrants. The dubious category of Supermicro fell from 16 to 9. CD-ROM was up, Floppy was down. Training went from 32 to 47, reflecting the increased complexity of the equipment.

One major increase was Modems, which jumped from 29 exhibitors in 1991 to 62 in 1992. You can thank the new chip sets for that increase.

So what can we conclude? Multimedia, modems, and more of the same. That's my guess. Whatever the case, it's going to be a good year.



Comdex 1992 was so big it blew away the old record. Imaging, multimedia, modems, and voice will be hot.

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Fast Format - quick repetition of text formats	Yes	No	No
SmartMerge step-by-step mail merge guide with a card file data manager	Yes	No	No
Preview of Style Sheets for memos, faxes, newsletters, etc.	Yes	No	No
WYSIWYG preview in File Open to quickly view, print, or extract text	Yes	No	No
More import/export filters	45	27	37
On-line Tutorial	Yes	Yes	No
Automatic re-numbering of lists	Yes	No	No
Customizable, editable, sizable, colorful SmartIcons™ for one click access to frequent tasks	Yes	No	No
In-context editing of drawings and charts	Yes	No	No
Laptop Install option for quick and minimal configuration on a laptop	Yes	No	No

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CIRCLE 053 ON READER SERVICE CARD

John C. Dvorak Inside Track

Intel expects to duplicate IBM's feat of **tripling the internal clock** of the 486 to produce a 99-MHz 486. It will be released sometime in 1993. The superchip will be released either as a microprocessor or as a **room heater** if Intel doesn't solve its heating problems with the new dense chip designs. Apparently, Intel has already **agonized** over the heating problems associated with the 586. Clock-doubled and -tripled chips produce even more heat. Once the heat problems are solved, we can assume that **quadrupled and quintupled** clocks will come into vogue. Most experts say we won't see the high speed on the bus itself, since once you get toward 100 MHz you start to produce all sorts of radio interference.

It's a shame that one-time Intel licensee Harris Semiconductor decided to focus on **gallium arsenide** rather than CMOS technology because it had developed the world's best CMOS fabrication techniques. Intel needs to buy a company like that.

Meanwhile, the **Pentium production schedule** has been knocked back by the surge in demand for the 486: Intel expects to ship 17 million of the things in 1993. This may increase further, since a court recently ruled that AMD could not use the Intel microcode any longer, forcing AMD to recode and probably **delay** full production of the AMD 486 clone.

Get a Clue Dept.: Rockwell and AT&T have **revolutionized telecommunications** with their inexpensive modem chips. If you haven't got a V.32bis 14.4-Kbps modem by now, then you should get one. You can find it for \$300 or less. **Folks, there is no excuse not to own one.** Even more **ludicrous** are the low-end "starter" modems. Rockwell has released a 2,400/9,600-bps data/fax modem on a PCMCIA card that it will sell to OEMs for \$19!

Losers' Dept.: Philips buys Vendex, calls it Magnavox, watches the company shrivel, then closes it. Now Philips buys and closes Signetics. So **the joke** becomes: How do you make a \$1 million company? Sell a \$100 million company to Philips!

Buzzword of the Month Dept.: Here's an item that will spice up conversation at the water cooler. It's a new technology that may develop into **America's answer** to the Japanese domination of flat-panel displays. Unlike LCDs, **field emission** flat-panel displays cost little and will not have such a miserable learning curve. Let's face it: LCDs have *not* come far considering how long they've been around. You'd think that color screens would be cheaper and huge **wall-size displays** would be available by now. The

*The antipiracy bill
that was ramrodded
through Congress is
aimed at pirate BBSs
run by kids. The penalty
for piracy is five years
in prison and \$250,000
in fines. Drug dealers
should be so punished.*

technology is being developed by an **American consortium** called Microelectronics and Computer Technology Corp. Participants include Control Data, Digital, Hewlett-Packard, IBM, and ZDS.

The Japanese Answer to the Hard Disk: While we attack the Japanese hegemony in flat-panel technology, the Japanese are trying to do something about American **dominance** in hard disks. The technique will be to give up on magnetic technology and go with **magneto-optical**. Nothing like trying an end run when you're boxed in. The Japanese are hoping to make breakthroughs, but most experts say they are **losing money** on every magneto-optical disk drive sold. Worse, they've been

unable to increase speeds enough to make the drives useful as hard disk replacements. The write speed is **painfully** slow, and the read speed is only down to 35 milliseconds. Still, the reliability seems stable, and the removable nature of the media is very **appealing**. Fujitsu has been showing a 1-inch-thick, 3.5-inch, 120MB optical drive and hopes to get the price to under \$1,000. Still **too expensive**, but can you imagine what life would be like if it could get a drive like that down to, say, \$100? When you look at one of these drives and compare it with a floppy disk drive, you can see that someday it too will cost only \$100 (or less).

Meanwhile, the American hard disk makers are already working on 0.9-inch hard disks as they eye the potentially **lucrative** PCMCIA market. I always thought the Japanese were the ones for making things smaller and smaller. Hard to top the American makers of shrunken hard disks.

Helping the Little Guy, NOT! Dept.: The Software Publishers Association ramrodded a bill through Congress, and the thing was immediately signed by the computer-illiterate president before any reasonable counterarguments could be made. It was an antipiracy bill apparently **aimed at pirate BBSs** run by kids. The penalty for piracy is now five years in prison and \$250,000 in fines. Drug dealers should be so punished. I agree that piracy is a **menace**, but I wonder if this law really protects anyone. The most pirated products are PC games. For the law to take effect, the pirate has to illegally copy 10 products that have a net value of \$2,500. A pirate could post 50 games and **not meet the criteria** for the bust. Again, the **little vendor** isn't protected by these measures. They protect only the profitable, big software companies. I still expect to see a **hapless systems manager get busted** for backing up a large installation that contains a few illegal copies of expensive programs. □



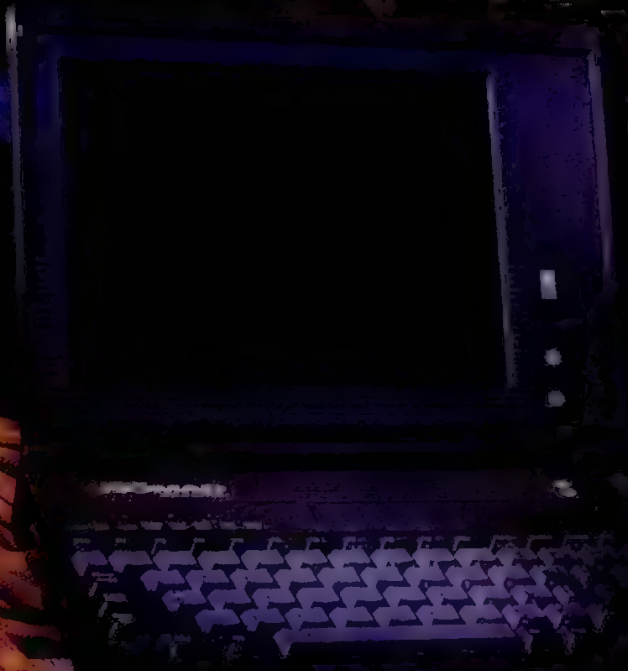
Base Camp



The Ascent



Reaching The Summit



Going to Extremes

If you want to know what the Gateway 2000 Nomad notebook PC can endure, just ask mountaineer Wally Berg. He took the Nomad 425DXL with him last fall on an expedition to the highest point on earth — the majestic, 29,128-foot Mount Everest in the Himalayan Mountains of Nepal.

Wally used the Nomad daily to track supplies, budget, and events of the climb. "Despite being transported over rugged terrain by yak, and operating in an unheated tent with temperatures outside of 20 to 30 degrees below zero, the Nomad performed flawlessly," said Wally. "The size was perfect, too. We had so many supplies to carry that size and weight were a big consideration."

Wally powered the Nomad with three sets of NiCad batteries which he recharged with a solar panel. Wally said the batteries weren't affected by the frigid temperatures. Each battery always lasted up to six hours.

The expedition left for its final climb to the Everest summit shortly after midnight on October 9. They ascended toward the peak by moonlight, reaching the top at 8 a.m. "It was a feeling of total exhilaration to finally reach the highest point in the world," said Wally.

Even if you don't plan to take your Nomad to Mount Everest, it makes the perfect traveling companion wherever you journey. The Nomad weighs just 5.6 pounds and measures 8.5 x 11 x 1.8 inches. Standard features include: a 25MHz Intel® 486SX or 486DX processor; 4MB RAM; an 80MB hard drive (425SXL model) or a 120MB hard drive (425DXL model); a 3.5-inch diskette drive; a 10-inch backlit VGA screen; a comfortable 79-key keyboard and FieldMouse™ portable pointing device; MS-DOS,® Windows™ and Works for Windows.™ Perhaps the most attractive feature is the price:

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NEC



Jim Seymour

The Multimedia Copyright Swamp

Walk new paths and you learn new ways. And sometimes you stumble over problems you may not have thought of before. Just ask anyone getting into multimedia. Give the typical PC user a scanner, sound board, and multimedia authoring

program, and he suddenly becomes a sponge of the world around him. If he can see it or hear it, then it's clearly his property—and likely to wind up in his productions.

The writer in me wants to add the line, "And he's going to wind up in jail." But, of course, that's not true: Stealing the intellectual property of others doesn't usually send you to the slammer, but rather subjects you to civil prosecution. And you and I both know that in that great cop-out of our times, you're not bloody likely to get caught using a stolen Monty Python sound byte or a luscious picture from *National Geographic*—or *Playboy*, for that matter—in your PC production.

Therein lies a dilemma for most new PC multimedia devotees: How far can you go, both legally and practically, in lifting pictures, sound, and video from the world around you for PC use?

The legal side of the equation is simple enough: You probably can't use it. The contents of this and virtually every other magazine are copyrighted, as are books, films, TV programs, tapes, CDs, and essentially anything else you might want to use. You can't legally use any of that material without obtaining written permission, which is almost always going to involve paying a fee for the reproduction or public-performance rights.

And it may take more than one fee: Willie Nelson, his record label, and the publisher of the song you want to use in your audio track all have ownership interests you must satisfy.

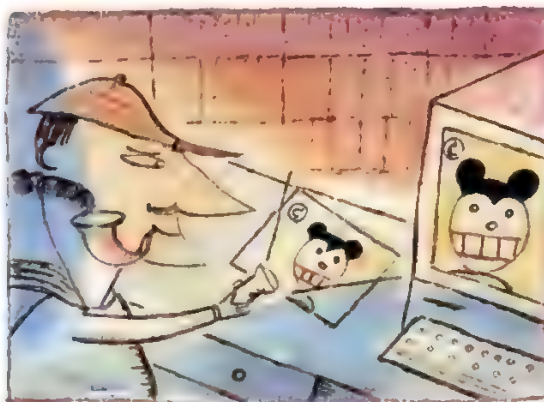
The rare exceptions, such as the Dover clip-art books, prove the point: you can't use it unless the work says you *can*—and you won't often find that. But again, the practical side seems to argue that since the owners are very

unlikely to catch you appropriating their property, you can probably use most of this stuff with impunity: Who's going to know?

ODD COUPLE OF WAVS

Thus, I have now heard the famous fake-orgasm scene from *When Harry Met Sally*. . . approximately a million times as a .WAV file in PC multimedia soundtracks. It's funny, it's unexpected, audiences (usually) love it. That track must be a close second to the collected works of the Pythons in terms of multimedia copyright abuse. Meg Ryan's coital exclamations and "Bring out yer dead!" are an odd pair, but some apparently think they have broad meaning for our times.

Hadn't thought of using those yourself? And now you're salivating at the prospect of using them? That's exactly what I was afraid of. Because talking about the ease of lifting others' work encourages it. The ubiquitous copiers, scanners, CD players, VCRs, and rental video tapes make breaking the law easy, to say nothing of breaking the covenant among us all that allows creative people to continue to work and to be properly compensated for that work.



"Borrowing" copyrighted material is still a crime. But vendors should make it easier to obey the laws.

There are, of course, other alternatives. Assuming you're not George Lucas, Bruce Weber, or Dave Grusin and are thus unlikely to produce your own stunning and original films, videos, photos, and sound tracks, you'll probably turn to the flood of video-, photo-, and sound-clip-file packages that have hit the market.

Unfortunately, that isn't always a good answer, either. It isn't just the quality of clip packages—which varies from superb down to plain embarrassing—but again, the legal and moral entanglements. Just because you *buy* clips,

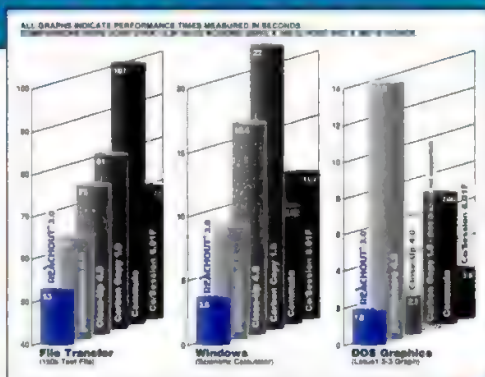
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Jim Seymour

it turns out, doesn't always mean you can use them.

Two products, both with very good material, illustrate the best and worst solutions to the problem.

The first is Prosonus MusicBytes, which is one of the best buys in the PC software business. Prosonus got together an extraordinary group of studio musicians, gave them a series of fine production-music charts, and laid down 27 very useful songs. Even better, it provides the music on the \$99 MusicBytes CD-ROM in cuts of many lengths. You can use anything from short stabs to longer passages. Better still, the files are provided in both .WAV and MIDI formats, so you can use whichever format provides the playback quality you need. There's even a standard CD-ROM audio format so you can preview the tracks on your stereo.

But best of all is the rights arrangement: You can use the tracks however you wish, except by re-releasing the material in competition with Prosonus. The company did an all-rights buyout from the composers and musicians and passes along that clean, worry-free, royalty-free status to those who buy the disk.

Then there's the clip-photo CD-ROMs from Hammerhead, distributed by a mail-order outfit, Starware Publishing. Hammerhead's Mother Earth II disk, for example, has 460 good to very good color photographs by Bruce Curtis. Many are useful thematic travel photos: sunsets; oceans, rural views. Hammerhead puts them on-disk in both VGA and 1,024-by-768, 256-color bitmaps. There are also utilities for limited editing of the images. So far, so good.

WHAT'S THE CATCH?

But when you read the fine print about rights, you find that the disk for which you've just paid \$59.88 turns out to be useless without additional payments: Hammerhead says in the fine print that these are stock photos for which you must buy publication rights from Starware. In other words, you can look, but you can't use.

Bah. Humbug. Rip-off.

Some suggest that in the Digital Era, copyrights are an anachronism we should abandon. Nonsense: We need copyright protection now more than ever. But we also need vendors who package and sell copyrighted work with a clear understanding of how we expect to use that work.

Prosonus got it right; Hammerhead missed by a mile. ☐

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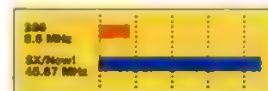
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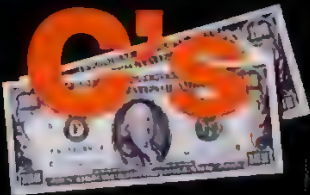
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CIRCLE 212 ON READER SERVICE CARD



Bill Howard

Small Breakthroughs

If you're underwhelmed by the current crop of subnotebook PCs, you're not alone. Here's the problem: You can have a system that weighs less than 4 pounds, has full functionality, and sports a low price. But it can only have two of these

attributes at a time. Subnotebook PCs are defined as keyboard-based Intel-compatible portable computers weighing 2.5 to 4 pounds, such as the Dell System 320SLi, Gateway 2000 HandBook, or ZDS Z-Lite. Anything smaller, such as the Hewlett-Packard 95LX, is a hand-held or palmtop PC; anything bigger is a notebook.

NO BACKLIGHT, NO SALES

The best-known subnotebook is the 3.6-pound Dell System 320SLi. Call me a cynic, but Dell's subnotebook looks more like a 5-pound notebook minus 1.4 pounds of essential features: a backlit display, a floppy disk drive, and a full-size battery. It's a fine piece of technology, but it may not be what the market wants. That's primarily because most users believe reflective (nonilluminated) displays are inappropriate on systems that call themselves full-functionality portables.

To save the reflective-screen chauvinists out there the hassle of writing complaint letters ("Dear Srir, this was witten on a reffettive displat suvvbotevook and I havve no problem readding the displat or typing on the compressef ketboard. . ."), let's handle their objections now:

Reflective technology is a lot better than it was in 1986. Yes, and it's still lousy, except for short periods or in good light.

You can't read an illuminated display outdoors at the beach. Say, aren't you the one who took your cellular phone and pager on your honeymoon?

You get twice the battery life. Which means you're squinting at a display you can't read for 6 hours instead of viewing one that you can read for 3. Anyway, actual battery life may be only 3 hours, because vendors use pint-size batteries knowing

3 hours is all that most users expect.

Then there's the floppy disk drive dilemma. A floppy disk drive weighs two-thirds of a pound and is a notebook's bulkiest component, so designers are tempted to move it outboard. But the overwhelming belief of portable-PC buyers is that anything that isn't a permanent part of the computer eventually gets lost: the transformer, the silly PCMCIA modem connector, the external floppy drive. Some people (me included) prefer an external floppy, but our numbers are small.

THE PRICE OF POWER

Even as we say we want small portables, we also want big hard disks, 486-class CPUs, 10-inch screens, even color displays. Add up everything business users want and you come close to the price, bulk, and weight of 5- or 6-pound notebook PCs.

Knowing this, product designers are reluctant to stick their necks out, especially given the cool reception afforded earlier ground-breaking, limited-functionality portables such as the NEC UltraLite and Zenith Mini-Port.

I believe there's room in the marketplace for two classes of subnotebooks. One is a 4-pound 486SL priced below \$2,000 with a backlit monochrome display, a 2.5-inch hard disk, and an external floppy drive. The other is a 2- to 3-pound notetaker and communicator with

a downsized keyboard and a smallish, illuminated VGA screen, no floppy, and a 40MB to 80MB hard disk—essentially the Gateway 2000 HandBook, but priced below \$1,000 and with a higher-performance CPU and a VGA display.

In other words, subnotebooks in 1993 will be incremental improvements on what we've seen in the recent past. No paradigm shifts here. □



Despite the hype, subnotebook PCs haven't caught on. Maybe the market wants more than technology allows.



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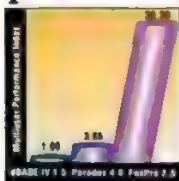


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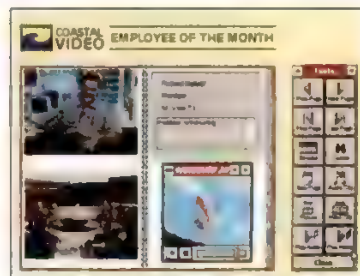
ing systems (and soon for the Macintosh® and UNIX®), you can have the most powerful and most graphical Xbase applications across all major PC platforms.

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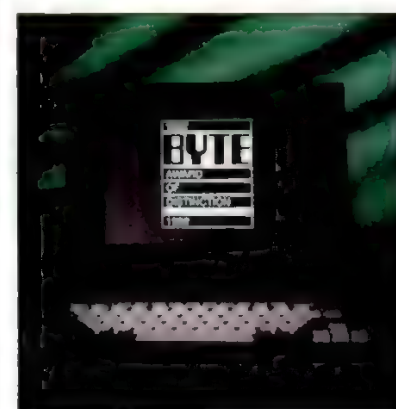
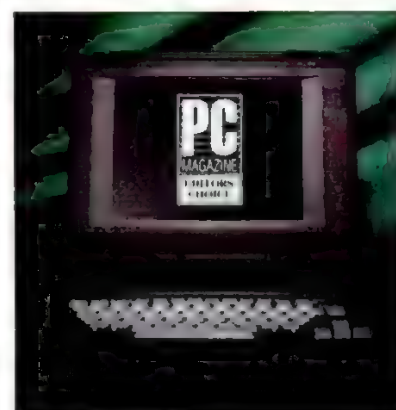
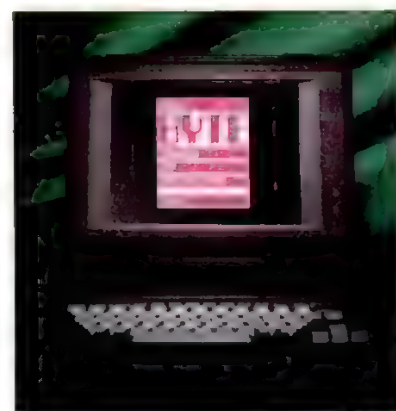
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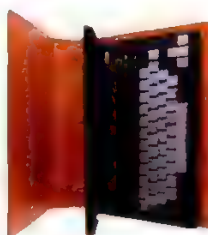
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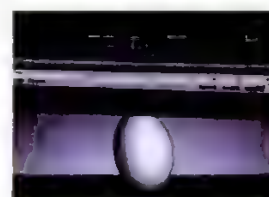
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- 2.5-HOUR BATTERY LIFE, UP TO 3.5 HOURS WITH POWER MANAGEMENT ENABLED
- MS-DOS 5.0

Cover Story

Low-Cost,



High-Feature PCs

These full-featured PCs reflect a current trend: to squeeze the most value from their under-\$2,000 price tags. But while some systems come with unexpected surprises, others come with compromises.

by Peter Lewis

It used to be axiomatic that a personal computer cost \$4,000. More than a decade ago, the first IBM PC system—the one with a whopping 64K of RAM and DOS 1.0 as an option—cost \$4,000. Over the years, that early system has been replaced several times, and although each new computer was ever more powerful than the previous version, it always seemed to cost \$4,000.

Then, last June, the bottom fell out. Compaq Computer Corp. fired the first shot in an emerging computer price war when it slashed prices on its high-end computers and introduced a new family of low-cost machines designed to bust clones, not budgets. It is unlikely that the average user will ever pay \$4,000 for a computer again—at least not for a single PC.

Suddenly, the idea of getting a full-featured, well-constructed PC for \$2,000—not some Frankenstein box from an unknown vendor, but a mainline system from an established PC company you can expect to remain in business—seems reasonable. For this review, then, we deviated from our usual practice of examining the



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latest and fastest of computers, to find out just how far the PC dollar goes.

We did not want close-out specials ("For sale: 500 new-in-box IBM PCs, \$2,000 or best offer") or a bargain-basement 386SX/20 with a lifetime supply of useless software and other detritus. Rather, we wanted a clean, powerful system that would be capable of running Microsoft Windows efficiently, today and tomorrow. Our mission was not only to find out what \$2,000 will buy in today's computer market, but also to find out what it doesn't buy: the features, components, and service we have for so long taken for granted, but are the first to be sacrificed.

Just a year ago, our candidates for the \$2,000 cutoff might have been rather anemic. As a result of the price war, however, we have found at least 61 mainstream candidates for this comparative review. And in the weeks since we invited com-

panies to submit machines for examination, prices have continued to drop.

How low can prices go? Analysts who watch the financial side of the industry say there is little air left to squeeze from profit margins or component costs, and from here on the squeezing will mostly yield red ink, placing some computer companies in jeopardy. Oddly, though, some of the most embattled computer companies say privately that they are willing to bleed cash until leaner competitors are starved out of the market.

The strategy is already working. Several large PC makers seem to be struggling, such as Everex Systems, which

has abandoned the PC camp to pursue bigger systems that presumably carry fatter profit margins. Some, like Packard Bell Electronics, had trouble making a profit even when times were flush. But the most likely victims of the price attrition war are the little companies, the ones that skate on the thinnest edge of profitability. Despite a brave front at the recent Fall Comdex trade show in Las Vegas, the smaller Taiwanese clone companies, for example, were noticeably edgy.

TOO GOOD A PRICE?

There is also a thin edge between a bargain and boondoggle. Buyers may be able to shave even a couple of hundred dollars off the prices listed on the following pages. But in the current market climate, with the big players running scared and with casualties expected to mount, the risk of being stuck with an "orphan" computer is always present. Experienced buyers can probably nurture an orphan computer to old age, but for beginners the lack of future support should at least be unsettling. A vendor's ability to survive should be a major part of your purchase decision.

Customers have definitely benefited from the computer price war, returning in droves to brand-name computer systems as their prices have dwindled. Companies like AST Research, Compaq Computer Corp., Dell Computer Corp., Gateway 2000, and IBM Personal Computer Co. have attracted so many customers that they have struggled to meet demand. Back orders for low-cost systems stretched from weeks to months for some popular systems, like the Compaq ProLinea line. The message was clear: Customers like low-cost computers, and it's not likely that prices will return to the days of 40 percent dealer margins.

To garner the profits needed to advance their PC research, that will lead to the next generation of machines, the major computer makers have adopted a split personality: Divide the firm's products into a "premium" line with advanced fea-

Our Contributors: PETER LEWIS is a free-lance writer and covers computers for *The New York Times*. OLIVER RIST is a staff writer, and BRAD GRIMES is an editorial researcher at *PC Magazine*. BRUCE BROWN is a contributing editor of *PC Magazine*. WILLIAM P. FLANAGAN is a support technician at PC Labs. ROBERT ANTHONY, ANDREW COLLIER, and HENRY FERSKO-WEISS are also free-lance writers on computers. BRIAN NADEL is an associate editor of *PC Magazine*.



EDITORS' CHOICE

• **Amax 486DX2/50 ISAMax
Power Station**

tures and higher prices, and a "value" line with solid but unremarkable technology and low prices.

Besides Compaq's ProLinea line (the junior side of its Deskpro family), Advanced Logic Research has created the ALR PowerFlex Flyer to go along with its high-end BusinessVEISA line; AST Research has its low-cost Bravo line to complement its Power Premium and Premium Exec lines; the newly autonomous IBM Personal Computer Co. has its ValuePoint line to contrast its PS/1 line (we reviewed one member of this family for this story) and the premium PS/2 family; Dell Computer Corp. has subcontracted its Dimension line to an outside company, while revamping its System family, and Hewlett-Packard Co. has created a Vectra N line to bolster its high-end U series.

The obvious question becomes, what does one give up by choosing the less-expensive system, instead of going for a company's premium line? In general, computer companies prefer to tout the service and support advantages of their premium lines, or talk about the distribution channel, because those issues are somewhat intangible. Yes, one can save money by accepting one year of on-site support instead of three, or a 48-hour service response time instead of a 4-hour period. And yes, prices can be lower if the machine is sold directly to the customer or through a discount chain that takes a smaller cut of the profits.

Let's face it, there have to be some technical tradeoffs when seeking the \$2,000 price point.

REVIEW CRITERIA

So what did we expect to get for \$2,000? Obviously, we were not anticipating state-of-the-art computer systems, with all the bells and whistles that come with more expensive units. We were surprised, however, at how much computer \$2,000 actually commands. We expected quite a lot for the money, but some of the test systems delivered even more.

Physically, the systems included tower, desktop, and mini-desktop models, offering users a wide range of choices. There was an abundance of external cache systems for revved-up processor performance. Nearly half of the systems

Value is a relative term; it attempts to resolve the inevitable conflicts between what you pay for and what you get. The budget-minded vendors that participated in this roundup sent us a total of 61 PCs that showed many different approaches to giving the

buyer the best value for the lowest price, and a configuration for just about every buyer. At the low end of this range was the surprisingly well-equipped Mega Impact 486SX/25+ at \$1,550 (with an estimated 15 percent street discount, this system will likely sell for about \$1,320). The \$2,300 Compaq ProLinea 4/33 was the most expensive. The watchword was value, and the result was a mixed bag: Some packages were more than the sum of their parts, and other computers were cut too close to the bone.

All told, three systems were able to combine an attractive price tag with outstanding performance and future expansion. We give an Editors' Choice to the Amax 486DX2/50 ISAMax Power Station, whose features and all-around performance you would usually expect from a system that costs much more. An honorable mention goes to the Austin 486/DX2-50 WinStation and the Insight 486-331 Cache: While they disappointed us in one area or another, both these computers are solid values and would satisfy most computer shoppers.

TO THE MAX

The Amax, which is based on Intel's high-power 486DX2/50 processor, achieved benchmark test scores that were at or near the top in six out of seven cases, and it was able to beat all the low-cost competitors in terms of its memory and DOSmark scores. This computer's only poor result was its DOS video score, but this drawback is balanced by the system's Graphics Winmark score of 5.94 me-

gapixels per second.

Solidly designed and engineered, the Amax is built from high-quality components that are assembled in a straightforward way. This system's only blind spot is that it could have had more features that would make upgrading easier, but this shouldn't be as important for a system that is built around one of the industry's fastest processors, as it would for those with less-able CPUs. The absence of flash BIOS or an OverDrive socket is curious in light of the PC's synthetic oscillator crystal, which can accommodate a variety of clock speeds.

The Amax is well laid out and offers good expandability, including an optional 2.1GB hard disk—one of the largest in this group. For the money, it is a sensational performer, both for today and tomorrow.

Two other systems distinguished themselves during evaluation and testing by giving more for less. The aptly named Austin 486/DX2-50 WinStation turned in Graphics Winmark and Disk Winmark scores that placed in the top five. When you take into account the WinStation's top-notch processor and memory scores, you have a quality system that can handle today's most demanding software. The Insight 486/331 Cache was one of the few systems that was able to combine all of these features in a full-size tower case, which is usually a \$200 premium for most computers. Never dipping below the average, the Insight's performance was even-keeled: Although it was never the best, it was always good.

incorporated some form of Windows graphics accelerator. And several had local-bus video systems, a relatively new scheme for pumping video information through the computer faster than if the graphics controller was plugged into a standard expansion slot. Speaking of expansion slots, EISA slots used to be featured on only the most expensive desktop systems, but a few showed up in our penny-pinching parade.

We asked each computer company to submit one computer, even though a vendor may have had several models that met our minimum configuration: 4MB of RAM, 200MB of hard disk storage, Super VGA graphics with a 14-inch color monitor, DOS 5.0, Microsoft Windows 3.1, a mouse, and a price tag that didn't exceed \$2,000. To account for the disparity between the suggested price and what a typical system actually sells for, we afforded a 15 percent discount to those companies

that sold through dealers, although lately we have seen this price cushion deflate. We tested the systems in late October, and prices are current as of late-November.

All told, we received 61 machines, from Acer America Corp. to Zenith Data Systems, that fit the bill. AST Research was absent because it could get no closer than \$90 to our target, but the company's recent price cut, which came too late for this story, would have made this unit eligible. There were three prominent no-shows that declined to participate: Northgate Computer Systems, Samsung Electronics America, and Wyse Technology. Others could not deliver a working machine that met our technical requirements: Blackship Computer Systems and Compudyne Products. But the bottom line is that there is no shortage of vendors ready, willing, and able to produce a quality machine for the money.

bays and bus slots to spare, flash BIOS, and easily upgradable processor/cache subsystems.

SERVICE AND RELIABILITY

In our 1992 Service and Reliability Survey, we sent questionnaires to 17,000 randomly chosen *PC Magazine* subscribers, and about half of them responded. Beginning with this issue, our PC round-ups will include summarized survey results, describing those vendors for which we received a statistically significant number of responses. We have rated the vendors *above average*, *average*, or *below average* in satisfying computer owners' needs:

Reliability indicates whether PC owners felt that their systems met, surpassed, or failed to meet their expectations; we found that most manufacturers met or exceeded the expectations of four out of five owners.

Repair service results were culled from those respondents who contacted the manufacturers to have PCs repaired. Nearly two-thirds of the respondents said that their expectations regarding manufacturers' repair service were not met.

Technical support fared somewhat better than repair services: Over half of those who answered indicated that their expectations were met or exceeded.

Suitability to Task: Low-Cost PCs

Of the 61 low-budget machines tested, only the Unitek UT-486DX50C combined high marks in all categories.

The rating for **DOS applications** describes the system's ability to run DOS software quickly and efficiently. To earn an *excellent*, a PC needs at least a 200MB hard disk and a DOSmark score among the top quarter of the reviewed systems.

Windows applications is a more demanding category; the rating indicates how well a PC will operate Windows software. Factors include Graphics and Disk Winmark scores, DOSmark score, the maximum motherboard RAM, hard disk options, the maximum noninterlaced resolution, the screen size, and the presence of a mouse port. Well-designed systems containing top-flight video controllers and fast hard disks received *excellent* ratings.

Expandability rates a system's potential for growth. Considerations include ease of processor and external cache upgrades, system BIOS, hard disk options, maximum RAM installable on the motherboard, available drive bays and bus slots, and 16550 Universal Asynchronous Receiver/Transmitter (UART) support. The best systems have drive

Product Name	
SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	FAIR
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair Service	AVERAGE
Tech Support	BELOW AVERAGE

The ground rules were simple: vendors could use any microprocessor, as long as it wasn't something embarrassing, like a 286. The minimum engine had to be a 386DX/33 or its equivalent. Even so, a few manufacturers slipped in the Cyrix Cx486SLC/25. The upstart Texas chip maker has some sprightly chips, including the Cx486DLC/40 used by two vendors in this pageant, but Cyrix's SLC line is the performance runt of the litter. Its lineage is genetically closer to the 386SX's than to the 486's and doesn't contain a floating-point unit. It does include a 1K internal cache, which pales in comparison with the 486's 8K. The lack of an external cache controller, common with some of the other systems in our survey, may have doomed the SLC-based PCs from CompuAdd Computer Corp. and C² Micro Systems to their dismal processor finishes.

As expected, the Intel 486SX chip was popular in this group, found in 20 machines. The SX version has been controversial ever since Intel announced it as a "crippled" version of the 486DX. The most important difference for the average user is that the DX's standard math coprocessor, which is important for processing graphics as well as for crunching spreadsheet numbers, is disabled on the SX chip. In general, the casual user may notice only about a 20 to 30 percent performance hit when using an SX chip.

If you plan to do a lot of processor-intensive applications, like sorting through a database, it makes sense to spring for a DX or DX2 chip. For word processing or other mundane tasks where the human is the system bottleneck, an SX may be the most cost-effective solution.

What we didn't see was the latest 486 chip: the 66-MHz clock-doubler chip. But more than half of the systems we tested used Intel 486DX/33, 486DX/50, or 486DX2/50 CPUs, which hold their own in any corporate environment.

Surprises are in store, however, for buyers who think the processor is the most important determinant of system performance. As our test results reveal, companies that cut corners elsewhere in order to afford a brawny processor often paid the price in terms of system performance. Some systems, such as the Telemart MITS HSY-88-486DX-5, ranked near the top of the pack in terms of its pro-

Price/Performance Index: *Low-Cost PCs*

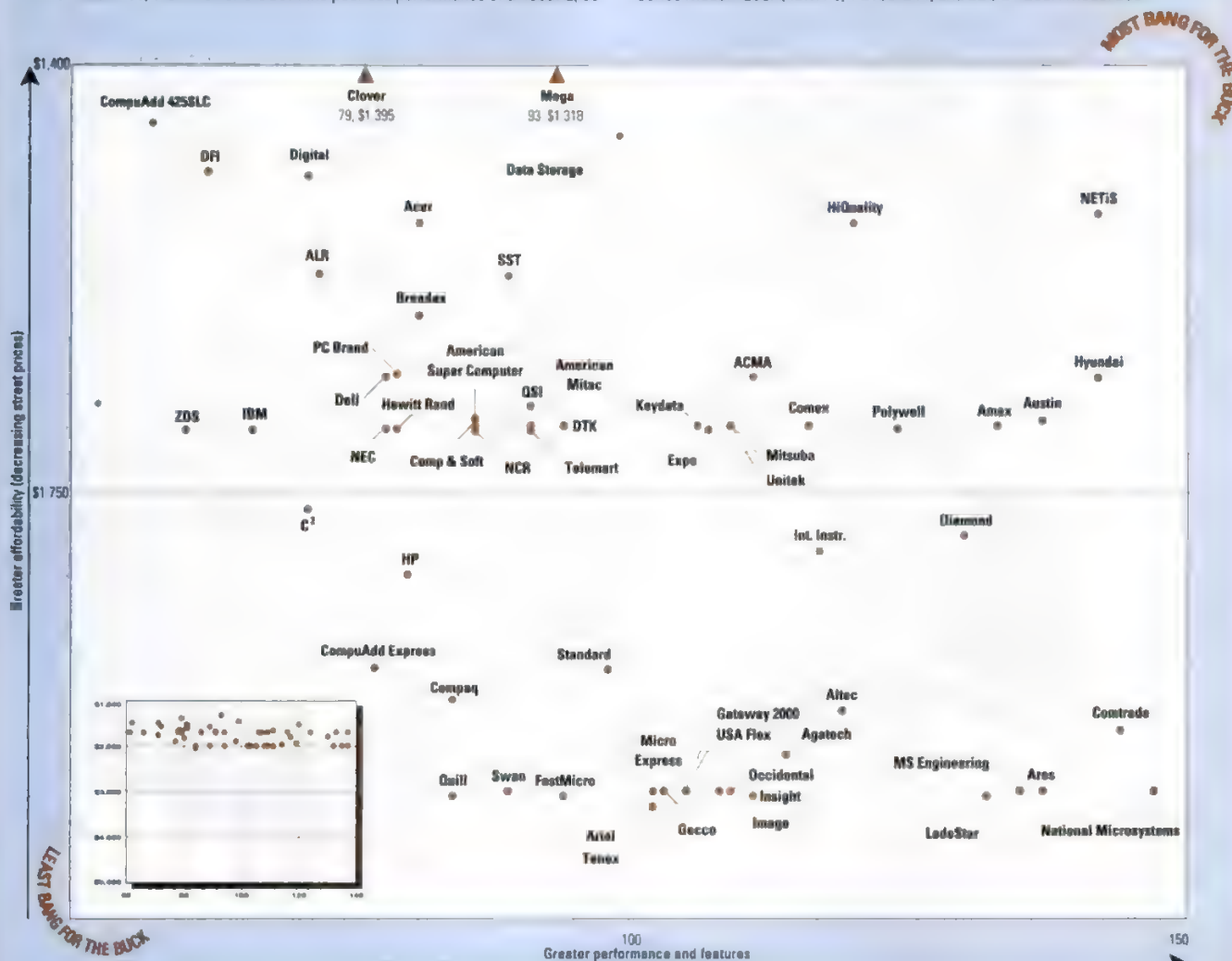
Bargain-basement processing power has arrived. From the \$1,318 Mega Impact 486SX/25+ to the \$1,999 Ariel and Tenex units, there are a multitude of systems that deliver high performance for a low price.

Twelve systems fall within the optimum bang-for-the-buck quadrant of our price/performance chart. The \$1,522 NETiS Ultra WinStation N433L was the best at combining price and performance. This 486DX/33 can accommodate up to 120MB of system memory and has a generous complement of expansion slots. Other top scorers under \$1,750 include the Amax 486DX2/50 ISAmix Power Station, Austin 486/DX2-50 WinStation, HiQ Ultimate 433i, Hyundai 433S, and Poly 486-50i. Of these PCs, the Amax offers both the peerless performance of a 486DX2/50

CPU and a full-size tower case that has plenty of room for extra drives and expansion. The Hyundai has a ZIF socket—a pleasant surprise in this class of machine.

The machine with the best performance turned out to be National Microsystems' \$1,995 Flash 486DX2-50 LB. Its composite performance/features score was just a shade better than those of the Amax, Austin, Ares, Comtrade, Hyundai, and NETiS units.

The lowest-priced PC, the \$1,318 Mega Impact 486SX/25+, included a 213MB hard disk and a performance/features mark just under the group average, making it a budget leader. Priced at or below \$1,750 are the price leaders; the weakest performers in this group included the CompuAdd 425SLC Low Profile, DFI Diamond Series Model 425SA, IBM PS/1 2155-G44, and ZDS Z-425SX Model 200



THE DATA POINTS

The Bang for the Buck performance index reflects each machine's benchmark test scores, hard disk capacity, installed RAM, video RAM, processor socket, flash BIOS, and expansion features such as available drive bays and expansion slots. The index also reflects important extras such as local bus, 16550 Universal Asynchronous Receiver/Transmitter (UART) support, extended warranty, on-site service, and bundled software. Benchmark test scores are weighted to account for half of the performance index; capacity and expansion features account for

45 percent, and the extras account for the remaining 5 percent. You can find more data in the PC MagNet's Software Library Editorial Forum as 04BANG.WK1.

Prices are based on our tested configuration (as listed in each product's fact file), and we discount dealer-distributed systems by 15 percent to approximate street prices.

The inset contains the same data, but presented in the conventional scale we typically use for the price/performance index. For details, see 04BANG.WK1 in the Software Library of PC MagNet's Editorial Forum.

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cessor speed, thanks to its 486DX/50, but near the bottom of the pile when it came to its hard disk access and video speed. Conversely, an otherwise mediocre chip can rise above its competitors by taking advantage of some crafty tricks. There are many different philosophies for finding the right balance of components.

A few vendors shorted us some megabytes of hard disk storage in order to meet the \$2,000 barrier, however: The DFI Diamond Series Model 425SA came with a paltry 120MB hard disk, for example, but would still have made the price cutoff with a larger disk. Most forked over at least 200MB, and a handful offered as much as 240MB. For the types of Windows applications that these machines are capable of handling, the space is not a luxury, it is a necessity. In the realm of computer graphics, a picture is worth a heck of a lot more than a thousand words in terms of the amount of storage space required. Gone are the svelte applications that once fit on a single floppy disk; today, some programs list their hard disk requirements in tens of megabytes.

Anyone planning to explore the possibilities of color computer graphics should think about buying additional hard disks, although use of such on-the-fly file compression utilities as Stacker can stretch hard disk space quite economically. We expect that Microsoft Corp.'s DOS 6.0 will incorporate a compression system.

An external processor cache generally speeds the system's performance by keeping frequently used code in high-speed memory, instead of making time-consuming treks to and from the regular memory chips (or, in the worst case, the hard disk). A nanosecond here and there really adds up, even for those of us who type with two fingers. Again, the quality of the memory subsystems was a surprise, with many examples of external caching and a few of elegantly-designed DRAM systems.

For those who see the glass as half empty, what you don't get for less than \$2,000 is significant. You don't get the 17-inch monitors that make Windows easier to maneuver, although a low-emission monitor is a possibility; you might not get the

advanced graphics systems that make Windows pop; you may not get two floppy disk drives; and you don't get service and support as soon as you hang up the phone.

The greatest stumbling block for these low-budget PCs was in the area of future expandability. Some in this class, including the HP Vectra 486/25N shortchanged the buyer, with only two drive bays. Others, like Agatech Computer Systems' AGA-DX33, were so sloppy that expansion slots were blocked by components like hard disks or power supplies. For more information, see the sidebar "What to Look For in a Budget PC."

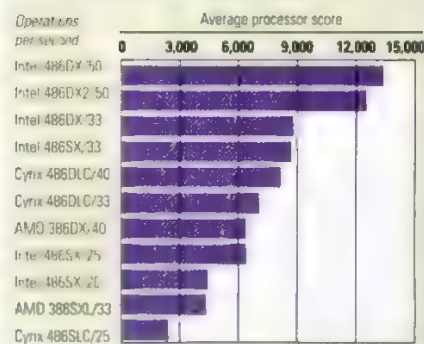
WHO SHOULD BUY ONE

The obvious customer for one of these price-performance standouts is the bargain hunter, who is looking for a product that is neither the ultimate powerbox nor the cheapest clone. We sought a comfortable balance between budget and brute force. There are certainly cheaper systems on the market, and prices will probably continue to erode for a while.

Most recently, Dell announced an \$800 system based on a 386SX CPU that with a monitor would cost just over \$1,000. In fact, the true bargain hunter may not want to buy any of these machines. If this industry's trend mongers are right, the price reductions will continue on a steady decline. A system that just missed our \$2,000 cutoff—for example, the Gateway 2000 4DX-33V, with a 200MB hard disk, a VESA local bus, 8MB of RAM, a 15-inch color monitor, room to expand, and a \$2,495 price tag—may fall within this story's price range before too long.

There are other possible factors to upset this scenario, of course. The failure

Processor Performance: How the PCs Fared



Note the fivefold difference in processing power between the Intel 486DX/50 and Cyrix 486SLC/25.

of a good-size PC company could lead to a dumping of inventory on the open market, depressing prices more sharply. Or demand for these systems could prove so great that the production backlogs will reduce any incentive to cut prices.

TO UPGRADE OR NOT

For those who think the upgrade path is a good compromise, be wary. Look carefully at the price difference between the dream machine and the one that fits our under-\$2,000 limbo bar. Yes, you can probably pop for a faster processor, more memory, a better monitor, or a roomier hard disk down the road when your wallet is fatter, but by that time you may be paying a stiff premium over the cost of a new system. Upgrades always cost more than one would anticipate, and "optional" technologies always become standard faster than we expect.

That isn't to say that upgrades are always messy and costly (for more information, see "Upgradable PCs, Dec 8, 1992"). In some cases, they are exactly the right strategy. But we discovered in some of these systems that internal design was often sacrificed to cut costs. Some of our contenders, like the Compaq, were elegantly laid out and well prepared for the upgrader. With other products—well, it was a jungle in there, with cables resembling a ball of mating rattlesnakes, slots that don't open or that take only half-length cards, components that block access to SIMM chips, missing processor upgrade

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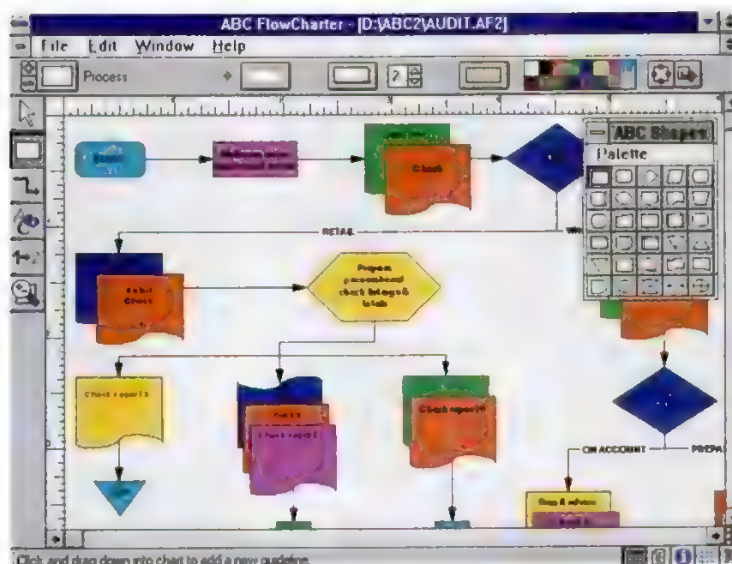
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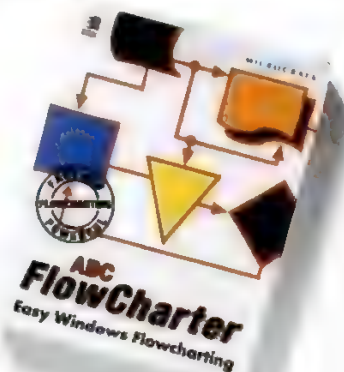
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CIRCLE 361 ON READER SERVICE CARD

■ What to Look For in a Budget PC

by Oliver Rist

Gauge your needs carefully before buying a PC with a sexy sub-\$2,000 price tag. It may look great on the showroom floor or in the mail-order ad, but your expansion and upgrade options may be limited.

Where can you find such low-priced computers? Today's cutthroat market has spawned a multitude of economical PCs. Be warned, though: This doesn't

mean that low-priced units from big-name manufacturers are necessarily comparable with their higher-end models, or that they're better than products from smaller vendors.

FEATURES TO LOOK FOR

Try to get as much as you possibly can for as little as possible. Many of the big-name vendors, for instance, shipped products with 170MB hard disks. If you

search, though, you can find as much as 245MB of storage. Make sure the hard disk uses one of today's interfaces: IDE or possibly SCSI.

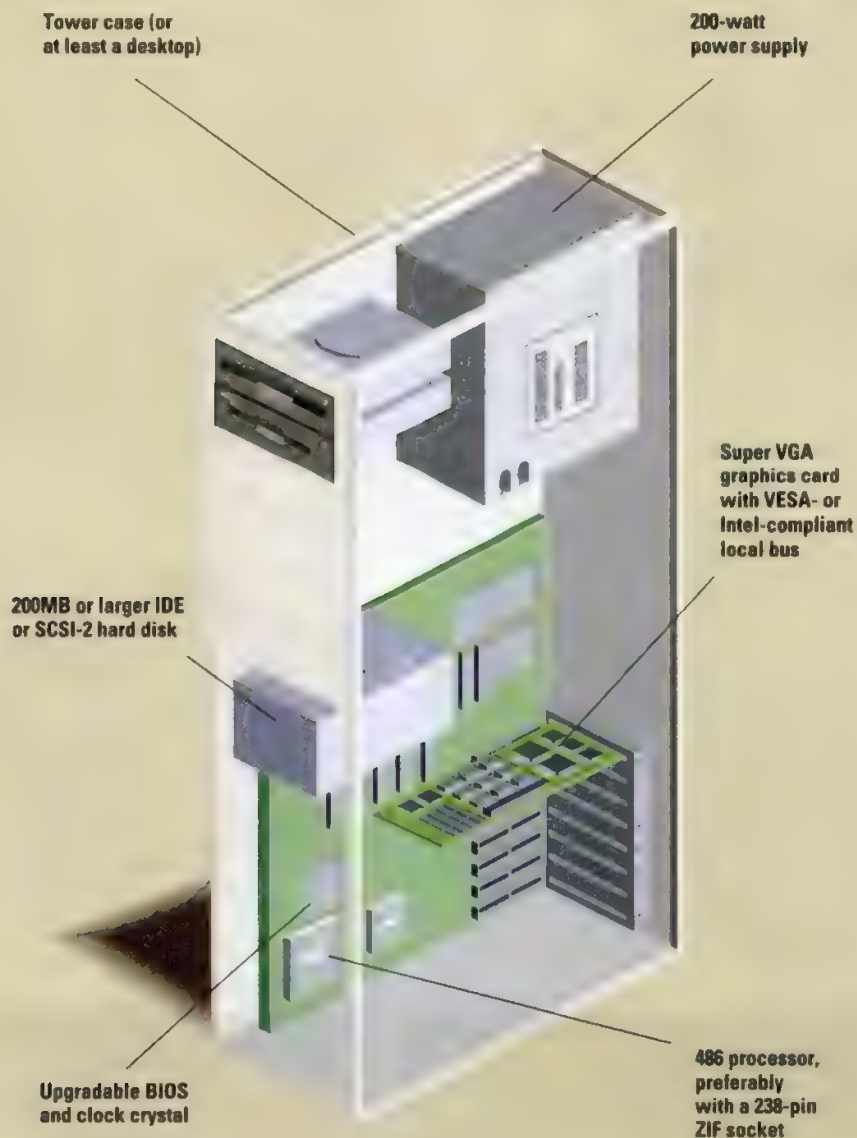
Keep an eye on graphics. Some systems use vanilla VGA cards with low-end monitors. This means that neither your graphics card nor your monitor can display anything better than VGA running at a flicker-rich 56-Hz refresh rate. For the sake of your eyesight and for performance reasons, we recommend a multiscanning monitor and graphics card that can handle Super VGA at VESA-compliant refresh rates (generally either 60 or 72 Hz). If you're into real graphics processing, 60 Hz is not enough, and you will most likely want 1,024-by-768, too.

Look for new graphics chip sets, not last-generation silicon. The Tseng ET4000 and Western Digital WD90C30 were good in their day, but you'll want those meeting today's standards, like WD's new WD90C31, S3's next GUI accelerator, or ATI's Mach 8 accelerator. Local-bus options are nifty. Avoid proprietary schemes; look for VESA's or Intel's upcoming PCI standards.

Last, stick to a 486-class chip. Though we received an Intel 386 and a few of Cyrix's 386/486 hybrid chips, Intel is now marketing full-blown 486DXs in this price range. Even a Cx486DLC combined with an 80387 math coprocessor couldn't match true 486DX or 486DX2 performance. Look for alternative processor sockets, like the ZIF sockets designed for Intel's easy-to-install OverDrive upgrade. Try to get one that has a 238-pin capacity so you can upgrade to Intel's first-generation Pentium CPU. Also, make sure you have the largest secondary external cache you can get; 128K is a suitable amount, but 256K is better for clock-doubling CPUs.

NASTY PITFALLS TO AVOID

Most of the big-name manufacturers like Compaq, CompuAdd, and Dell decided that "low-cost" means cram-



ming everything into a slimline case. We prefer at least a small-footprint desktop case, not just because it offers extra drive bays and usually has at least a 200-watt power supply, but also because you'll have an easier time getting to your motherboard. Dense cabling and oddly configured drive-bay assemblies that hide critical motherboard components make alterations a headache. If you can get inside a PC before you buy it, look for engineering flaws, like a higher-end processor without a heat sink or cooling fans.

Check the motherboard to make sure you *can* upgrade. SIMM chips for RAM and external cache memory mean you can perform an upgrade yourself. Make sure your BIOS can handle a change of oscillator and processing power.

Though there are no proven downsides to buying a PC that uses off-shore or little-known components, there are some risks. Trying to get technical support from Taiwan is expensive to say the least—if you can even get the name of the OEM. The American vendor may say it can provide technical support, but if this is wrong, you're the one who will suffer.

The warranty is another good reason to look for name-brand components. Many smaller and hungrier vendors are now offering stunning warranties: up to three years with on-site service included in many cases. But today's little-known vendor may be tomorrow's bankrupt computer maker. If the maker used name-brand components—Conner, Maxtor, or Seagate hard disks; Micronics or Orchid motherboards; Sony or TEAC floppy disk drives; MAG, Nanao, NEC, or Sony monitors; and ATI, Genoa, or Orchid video cards—you can get warranties filled on these individual components.

Be careful. Check the reviews. Talk to people in the business (many are available on-line). If you do your homework now, you'll save a little money—and you'll also feel a lot safer. □

slots, and a generally poor design. There are all sorts of hidden booby traps that can make a move to future technologies a risk. The prospect of tapping into the Pentium chip's expected 100 MIPS may make you drool, but its anticipated power consumption may turn your system into the functional equivalent of a space heater with a monitor.

That's why fewer than 10 percent of the people who buy upgradable PCs actually perform the upgrade, according to AST Research, a company that produced one of the easiest upgrade paths. Another risk is to accept less computer than you'd like, with the expectation of upgrading the system later for a small additional expense. To be sure, some people have no flexibility in the budget and need a working machine immediately.

SELECT WITH CARE

Naturally, a great concern is whether companies are choosing "cheap" components, or scrimping on service and support, in order to meet the new pricing requirements. After all, everyone suspects that if (or when) our \$2,000 systems fail, it will probably be the fault of a 25-cent part that replaced a 50-cent part.

We were impressed with the high quality of the machines submitted to PC Magazine Labs. From chip sets to hard disks, many of the systems used top-quality components. There were some examples, however, of flimsy cases, flickery monitors, phantom slots, mushy keyboards, and hard disks that do not quite fit into their allotted spaces; these problems, which we mentioned in the product reviews, are the unfortunate byproducts of a company's zeal to save a few bucks.

More likely, a company will choose between an excellent component and a very good component, and will place the very good component in these budget-priced systems. In today's competitive environment, no major company would risk its reputation by knowingly using third-rate parts. For this review, we include the results of our biannual service and reliability survey summarized in the suitability to task section of each review.

A random and unscientific survey of corporate buyers revealed that most professed happiness with the new crop of low-cost systems, especially those from established brands. Some were gleeful, in

fact. However, some respondents griped about long waits on the telephone help lines. It is unclear whether this is because the number of service and support technicians has been cut, or if the vendors were caught off guard by the demand.

Remember that one way a company can persuade its business customers to pay more for one of its PCs instead of buying another company's less expensive and similarly configured PC is to offer more hand-holding. Several of the major vendors promise superior support for their premium lines, and if you're used to that, the "average" support packages may be frustrating.

And, of course, some of the companies in this survey don't include a year of on-site service, charging upward of \$100. Many of the companies have adopted 30-day money-back guarantees. In theory, this is a "no questions asked" policy, but in practice the company will obviously want to know why you're sending back a system it lovingly handmade for you. Check first to see who pays for the return shipping. Most of the time you will be responsible.

The best strategy, obviously, is to try to take the system for a test spin before you buy it. The nice thing about the \$2,000-and-under category is that the more popular models are often on display in local discount stores. Whenever possible, try the keyboard and stare at the monitor: Don't underestimate the importance of testing the keyboard and monitor for their esthetic value. Those are the two parts of the "user interface" that will affect you most directly, and they are also two components that are most susceptible to scrimping in the low-cost category. If you're even slightly uncomfortable with either, those annoyances will grow.

Unfortunately, the monitors chosen for many of the systems we tested were of average quality at best. Going to one of the larger systems with a faster refresh rate may push the package over the price barrier, but sensitive viewers may find the added expense worthwhile.

By choosing carefully from the following selections, the odds are great that you'll never need to worry about such defensive measures. The computer industry has matured, and there is new appreciation among vendors for customers who value a bargain.

Interested in a



486 DX-33 MHz
4 MB RAM, 85 MB Hard Drive



486 DX-33 MHz
4 MB RAM, 120 MB Hard Drive



486 DX-33 MHz
4 MB RAM, 200 MB Hard Drive



486 DX-33 MHz
8 MB RAM, 85 MB Hard Drive



486 DX-33 MHz
8 MB RAM, 120 MB Hard Drive



486 DX-33 MHz
8 MB RAM, 200 MB Hard Drive



Color 486 DX-33 MHz
4 MB RAM, 85 MB Hard Drive



Color 486 DX-33 MHz
4 MB RAM, 120 MB Hard Drive



Color 486 DX-33 MHz
4 MB RAM, 200 MB Hard Drive



Color 486 DX-33 MHz
8 MB RAM, 85 MB Hard Drive



Color 486 DX-33 MHz
8 MB RAM, 120 MB Hard Drive



Color 486 DX-33 MHz
8 MB RAM, 200 MB Hard Drive



486 DX2-50 MHz
4 MB RAM, 85 MB Hard Drive



486 DX2-50 MHz
4 MB RAM, 120 MB Hard Drive



486 DX2-50 MHz
4 MB RAM, 200 MB Hard Drive



486 DX2-50 MHz
4 MB RAM, 240 MB Hard Drive



486 DX2-50 MHz
8 MB RAM, 85 MB Hard Drive



486 DX2-50 MHz
8 MB RAM, 120 MB Hard Drive



486 DX2-50 MHz
8 MB RAM, 200 MB Hard Drive



486 DX2-50 MHz
8 MB RAM, 240 MB Hard Drive

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486 notebook?



486 DX2-50 MHz
16 MB RAM, 85 MB Hard Drive



486 DX2-50 MHz
16 MB RAM, 120 MB Hard Drive



486 DX2-50 MHz
16 MB RAM, 200 MB Hard Drive



486 DX2-50 MHz
16 MB RAM, 240 MB Hard Drive



Color 486 DX2-50 MHz
4 MB RAM, 85 MB Hard Drive



Color 486 DX2-50 MHz
4 MB RAM, 120 MB Hard Drive



Color 486 DX2-50 MHz
4 MB RAM, 200 MB Hard Drive



Color 486 DX2-50 MHz
4 MB RAM, 240 MB Hard Drive



Color 486 DX2-50 MHz
8 MB RAM, 85 MB Hard Drive



Color 486 DX2-50 MHz
8 MB RAM, 120 MB Hard Drive



Color 486 DX2-50 MHz
8 MB RAM, 200 MB Hard Drive



Color 486 DX2-50 MHz
8 MB RAM, 240 MB Hard Drive



Color 486 DX2-50 MHz
16 MB RAM, 85 MB Hard Drive



Color 486 DX2-50 MHz
16 MB RAM, 120 MB Hard Drive



Color 486 DX2-50 MHz
16 MB RAM, 200 MB Hard Drive



Color 486 DX2-50 MHz
16 MB RAM, 240 MB Hard Drive

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Intel 486DX2-50MHz Processor, 4MB RAM upgradeable to 32MB RAM, High Performance CONTAQ Chipset, 128K Memory Cache, 130MB 14ms IDE Hard Drive with 64K Segmented Cache upgradeable to 340MB, SCSI 512K Cache with 16-bit SCSI Controller, 1.2MB 5.25" Floppy Drive, 1.44MB 3.5" Floppy Drive, 16-bit SVGA, 1MB with a 14" Color Super VGA Monitor Non Interlaced, 0.28mm Dot Pitch, 1024x768 Resolution, upgradeable to 17" Non Interlaced, 129-Key, Calculator and Programmable Keyboard.

486 DX-50MHz EISA \$3475

Intel 486DX-50MHz EISA Processor, 8MB RAM upgradeable to 64MB RAM, High Performance CONTAQ Chipset, 256K Memory Cache, 340MB 14ms SCSI Hard Drive with 512K Multi-Segmented Cache, upgradeable to 1.2 Gigabyte SCSI, 32-bit EISA SCSI Controller, 1.2MB 5.25" Floppy Drive, 1.44MB 3.5" Floppy Drive, 16-bit SVGA, 1MB with a 14" Color Super VGA Monitor Non Interlaced, 0.28mm Dot Pitch, 1024x768 Resolution upgradeable to 17" Non Interlaced, 129-Key, Calculator and Programmable Keyboard.

486 DX2-66MHz EISA \$3275

Intel 486DX2-66MHz EISA Processor, 4MB RAM upgradeable to 32MB RAM, High Performance CONTAQ Chipset, 256K Memory Cache 200MB 14ms SCSI Hard Drive with 128K Segmented Cache, upgradeable to 1.2 Gigabyte with Controller, 32-bit EISA SCSI Controller, 1.2MB 5.25" Floppy Drive, 1.44MB 3.5" Floppy Drive, 16-bit SVGA, 1MB with a 14" Color Super VGA Monitor Non Interlaced, 0.28mm Dot Pitch, 1024x768 Resolution upgradeable to 17" Non Interlaced, 129-Key, Calculator and Programmable Keyboard.

386 SX-33MHz \$975

Intel 386SX-33MHz Processor, 1MB RAM upgradeable to 16MB RAM, High Performance UMC Chipset, 40MB 16ms IDE Hard Drive with 32K Segmented Cache upgradeable to 340MB, SCSI 256K Cache with Controller, 1.2MB 5.25" Floppy Drive, upgradeable to include 1.44MB 3.5" Floppy Drive, VGA Card with Video RAM 256K, 14" VGA Color Monitor, upgradeable to 17" Non Interlaced SVGA Color Monitor, IDE Hard and Floppy Controller, 101-Enhanced Keyboard upgradeable to Calculator Keyboard.

486 DX-33MHz \$1675

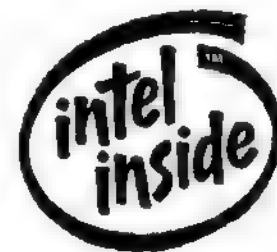
Intel 486DX-33MHz Processor, 2MB RAM upgradeable to 32MB RAM, High Performance CONTAQ Chipset, 128K Memory Cache, 85MB 14ms IDE Hard Drive with 64K Segmented Cache, upgradeable to 340MB, SCSI 256K Cache, 1.2MB 5.25" Floppy Drive, 1.44MB 3.5" Floppy Drive, 16-bit SVGA, 1MB with a 14" Color Super VGA Monitor Non Interlaced, 0.28mm Dot Pitch, 1024x768 Resolution upgradeable to 17" Non Interlaced, 129-Key, Calculator and Programmable Keyboard.

486 DX-50MHz \$2475

Intel 486DX-50MHz Processor, 4MB RAM upgradeable to 32MB RAM, High Performance CONTAQ Chipset, 128K Memory Cache, 130MB 14ms IDE Hard Drive with 64K Segmented Cache upgradeable to 340MB, SCSI 512K Cache with 16-bit SCSI Controller, 1.2MB 5.25" Floppy Drive, 1.44MB 3.5" Floppy Drive, 16-bit SVGA, 1MB with a 14" Color Super VGA Monitor Non Interlaced, 0.28mm Dot Pitch, 1024x768 Resolution, upgradeable to 17" Non Interlaced, 129-Key, Calculator and Programmable Keyboard.

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Intel 486DX2-66MHz Processor, 4MB RAM upgradeable to 32MB RAM, High Performance CONTAQ Chipset, 128K Memory Cache 210MB 14ms IDE Hard Drive with 64K Segmented Cache, upgradeable to 1.2 Gigabyte with 32-bit SCSI Controller, 1.2MB 5.25" Floppy Drive, 1.44MB 3.5" Floppy Drive, 16-bit SVGA, 1MB with a 14" Color Super VGA Monitor Non Interlaced, 0.28mm Dot Pitch, 1024x768 upgradeable to 17" Non Interlaced, 129-Key, Calculator and Programmable Keyboard.



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Specifications for our 486 notebooks

486 DX-33 MHz Series: Intel 486DX-33 Microprocessor. Socket for 80387 WEITEK 3167 math coprocessor. Easy Access menu, MS DOS 5.0, MS Windows 3.1, Fastback Plus backup program, Untouchable Virus Protection program, ALL INSTALLED. Black Leather Carrying Case and External Numeric Keypad included. Monochrome Display - 10" Supertwist LCD with CCFT backlit. 640x480 Pixels Resolution with 32 Gray Scale Levels. VGA/EGA/CGA/MGA/Hercules Compatible Mode. Brightness and Contrast Control. Programmable Screen Saver. Color Display - Standard Passive Matrix 10" Supertwist LCD with CCFT backlit. 640x480 Pixels Resolution with 8 colors, VGA Emulation of 256 Colors. Brightness and Contrast Control. Programmable Screen Saver. One 3.5" 1.44MB Micro Floppy Disk Drive. Built-in 2.5" Hard Disk Drive. Access time for 120 MB is 15ms, for 200MB is 14ms. AT-Bus Interface. Programmable Power Down Feature. Two Serial Ports. One Parallel Port for printer. 15-Pin

External Video Port. One External CRT Port for a monitor up to a Color 1024x768 Super VGA Non Interlaced Monitor. External Numeric Keypad Port (2 wires). One External Port for 101/102 Keys Keyboard. AT-Bus I/O (100 Pins) for Docking Station. Enhanced Multifunctional Keyboard. Special Fn Key for Extended Function. Multinational Key Legends. Integrated Numeric Keypad. Full Range Autoswitching AC Adaptor. Changeable and Rechargeable Ni-Cad Battery Packs. Quick Charging time 2 hours only. Battery life lasting for 3.5 hours. Dimension & Weight - 280mm(W) x 220mm(D) x 54mm(H); 11"(W) x 8.6"(D) x 2"(H); 3Kg or 7lbs (with battery).

486 DX2-50 MHz Series: Same as above except: Intel 486 DX2-50 Microprocessor; Internal Trackball; Weight - 3Kg. or 7lbs. (without battery); 4Kg or 9lbs (with battery).

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Acer America Corp.

Acer Acros 486SX/25

The Acer Acros 486SX/25 has a fairly low, \$1,799 list price, but its 25-MHz 486SX CPU, lack of external RAM cache, and generally slow performance prevent the system from being a great bargain.

With a Maxtor hard disk, an Acer 14-inch monitor, an internal fax modem using Delrina Technologies' WinFax 2.0, and a Cirrus Logic video chip set, the Acer stacks up fine in terms of component comparisons. Nonetheless, with the exception of its video and memory scores, which were average, the components fared poorly on our test routines.

On our crucial Graphics Winmark test



FACT FILE

Acer Acros 486SX/25

Acer America Corp., 2641 Orchard Pkwy.,
San Jose, CA 95134; 800-733-2237,
408-432-6200; fax, 408-432-6221

List price (tested configuration): \$1,799

Memory and processor RAM cache: 4MB 80-ns
SIMMs

Disk drives and controller: Maxtor 7213AT 15-ms
213MB IDE hard disk with 64K cache, integrated hard
disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Integrated video controller with 512K DRAM,
Acer AcerView 33D 14-inch monitor with a 56-Hz
refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, Microsoft
Works for Windows 2.0, Delrina WinFax 2.0

In short: At \$1,799, the price is certainly right, but
the Acer Acros 486SX/25 performed below the
average, particularly in the Windows disk and video
testing

478 ON READER SERVICE CARD

Acer Acros 486SX/25

SUITABILITY TO TASK

DOS
applications **GOOD**

Windows
applications **FAIR**

Expandability **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **BELOW
AVERAGE**

Repair
Service **BELOW
AVERAGE**

Tech
Support **BELOW
AVERAGE**

routines, the Acer PC fell to the bottom third of the pack; this may have been caused by the monitor's slow 56-Hz refresh rate. Its other test scores, including its DOSmark score, also placed the unit in the pack's bottom half.

The motherboard will accept higher-level 486 CPUs, including DX/33, DX/50, DX2/50, and DX2/66 units. But the idea of using a higher-power CPU in this cacheless system, especially a DX2 model, is questionable, although you can purchase up to 256K of external RAM.

The Acer's weak standing was not helped by its less than sturdy case. This small-footprint model has four drive bays and four expansion slots. The elements of the plastic case reinforced each other, but when we removed its top, the case flexed very easily and the front plastic cover became loose.

The one-year on-site service contract is a nice touch for a system sold primarily by value-added resellers, which are likely to give further discounts on the already low price. But for a few hundred dollars more, it may be worthwhile to investigate some of the other offerings in the under-\$2,000 range.—Bruce Brown

ACMA Computers Inc.

ACMA 486/33i

The \$1,948 ACMA 486/33i, from ACMA Computers, is not the fastest unit tested in this review, but even with its mixed results on PC Magazine Labs' benchmark tests, this well-equipped system is a solid purchase.

The ACMA's baby-AT-style case is sturdy and has a small footprint—a good base for this system. Inside there are four drive bays and room for full-size expansion cards in the eight ISA slots. One of the drive bays is under the computers power supply, which is

ACMA 486/33i

SUITABILITY TO TASK

DOS
applications **GOOD**

Windows
applications **GOOD**

Expandability **FAIR**



FACT FILE

ACMA 486/33i

ACMA Computers Inc., 48501 Warm
Springs Blvd., Fremont, CA 94539; 800-786-
6888, 510-623-1212; fax, 510-623-0818

List price (tested configuration): \$1,948

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 256K external cache

Disk drives and controller: Conner CP30174E 17-
ms 170MB IDE hard disk with 32K cache, UltraStor
15C ISA card disk controller with 512K cache, dual
1.2MB/1.44MB floppy disk drive.

Display: NDI Volante Warp10 ISA card video controller
with 1MB DRAM, Seiko Instruments CM1450 14-inch
monitor with a 72-Hz refresh rate at 1,024-by-768
noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, Microsoft
Works for Windows 2.0.

In short: Despite excellent components, this PC had
mixed performance results on our benchmark tests.

480 ON READER SERVICE CARD

a somewhat awkward location.

The system's 14-inch Seiko monitor with a Sony Trinitron picture tube has a maximum noninterlaced resolution of 1,024-by-768 at a VESA-compatible 72-Hz refresh rate; it performed fairly well during our testing. The NDI ISA card video controller with 1MB of video memory was a powerful performer under Microsoft Windows, producing one of the fastest Graphics Winmark scores of the test group. The ACMA's speedy score on our memory test routines was one of the ten fastest.

In contrast, the system generated very low DOS disk and Disk Winmark scores, along with a low DOS video result. The Conner 170MB hard disk is a little smaller than the 200MB units that came with most of the other units we

tested, but for this computer, ACMA doesn't sell a hard disk closer in size to the 200MB unit we requested for this test. With its own 32K of cache and an UltraS-tor IDE disk controller with a 512K cache, it still rated quite poorly on our benchmark tests.

The use of a 33-MHz Intel 486DX CPU with a 256K external RAM cache and 4MB of RAM led the ACMA to respectable but uneven performance, suggesting that a little fine tuning might be in order, especially to improve the hard disk response time and throughput.

A one year parts-and-labor warranty that includes on-site service from TRW makes this system from a competent mail-order company an attractive buy.—BB

Agatech Computer Systems

AGA-DX33

The AGA-DX33 is virtually identical to the system produced by its parent company, American Mitac Corp., but costs \$30 less. In fact, the Agatech contains a superior graphics adapter, and its case is larger than that of the American Mitac D4033.

The \$1,965 Agatech uses the same motherboard, processor, hard disk, and

disk controller as the American Mitac system, but both machines suffer from unimpressive components. A Logitech mouse was included.

The Agatech's mini-tower case is larger than its cousin's; even with the extra room, the Agatech actually provides about the same expansion possibilities as an ordinary case does, because access to internal components is drastically limited. In a tower configuration, the bottom of the motherboard is always facing toward one of the sides, making that side completely inaccessible. The available side is blocked by a wide support chassis and an unfortunate placement of the power supply and hard disk.

Meanwhile, the hard disk is mounted vertically, with its backside facing the side you would use to access the machine's

internal components. If you want to plug in a full-length expansion card, you have to remove the hard disk, while it would be difficult to reach the memory without removing the power supply.

Performance for the Agatech was practically identical to that of the American Mitac, with most scores ranging slightly above the average. The exception was its video performance, which was superior under both DOS and Microsoft Windows. Its impressive Graphics Winmark score fell within the top ten and was likely the result of the Diamond video card, which had the new and speedy WD90C31 chip set.

Agatech Computer Systems covers this computer with a one-year parts-and-labor warranty, with added free on-site support from Dow Jones Retrieval. The company also offers a 30-day money-back guarantee.—*Oliver Rist*



FACT FILE

AGA-DX33

Agatech Computer Systems, 48571 Milmont Dr., Bldg. B, Fremont, CA 94538; 800-568-6972, 510-623-5341; fax, 510-623-5390

List price (tested configuration): \$1,965

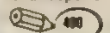
Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache

Disk drives and controller: Conner CP30204 12-ms 213MB IDE hard disk with 256K cache, Vitex Super I/O ISA card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond SpeedSTAR 24X ISA card video controller with 1MB DRAM, American Mitac M1558 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The AGA-DX33 and American Mitac D4033 are almost identical; the Agatech's video card, though, is far superior.



ON READER SERVICE CARD

Advanced Logic Research Inc.

ALR Flyer RS170 4/25s

The \$1,848 ALR Flyer RS170 4/25s has a good construction and design, but these fail to overcome the limitations of mixed performance scores and somewhat limited expansion room.

The ALR's slimline case is recommended for those who don't want to take up too much desk space. The sturdy case is nicely finished inside and out.

Because of its small size the Flyer has only three standard ISA expansion slots and three drive bays (on the tested PC, one drive bay was empty, one held a floppy disk drive, and the last contained a hard disk). Some expansion-minded buyers will see this as limiting. There's also a proprietary expansion slot.

The ALR wasn't equipped with an external RAM cache, though there is a dedicated slot for an optional cache; ALR offers a 256K cache, but with a \$395 price tag, it is not much of a deal.

The modular CPU card also makes upgrading easy though expensive; prices range from \$995 for a 486DX/33 to \$1,295 for a DX2/66. As usual with upgradable systems, you're better off buying the system with the CPU you desire instead of adding it later.

Most of the ALR's scores on PC Magazine Labs' benchmark tests fell near the middle of the pack. But the unit's Conner 170MB IDE hard disk with a 32K cache and motherboard-integrated disk controller produced below-average DOS disk and Disk Winmark scores. The integrated video controller with 1MB of video memory also logged a below-average Graphics Winmark score.

On-site service during the one-year warranty period costs a nominal \$9.95. This system would perform adequately for a single user using less demanding ap-

ALR Flyer RS170 4/25s

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Expandability **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **AVERAGE**

Repair Service **BELOW AVERAGE**

Tech Support **BELOW AVERAGE**



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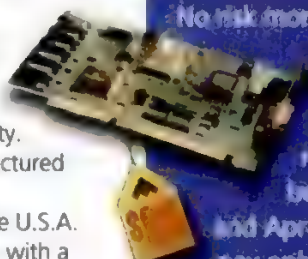
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► BENCHMARK TESTS: LOW-COST PCs

What the Numbers Mean

Test results show that there is no shortage of performance in systems with price tags under \$2,000. They may be low-cost, but they are certainly not low-power.

PROCESSOR AND MEMORY

We saw 11 different processor categories among the 61 tested systems. The average score for each processor type may be seen in the chart "Processor Performance: How the PCs Fared" in this article's introduction.

As expected, the two systems with Intel 486DX/50 chips, the Unitek and Telemart computers, attained the best processor scores. Both systems included 256K of external direct-mapped write-back cache with OPTi cache controllers. The nine 486DX2/50 systems were next in line; all had at least 64K of external cache—the minimum we recommend for clock-doubled systems.

The C² system and the CompuAdd 425SLC Low Profile, based on the Cyrix Cx486SLC/25, placed last, partly because of the chip's 1K of internal cache (compared with 8K on Intel 486 processors). Also, the Cyrix SLC chips have only a 16-bit interface to external memory and no burst-mode data-transfer capability. Among our processor test routines, Cyrix-based systems suffered most on the 48K standard instruction mix.

Memory subsystem speeds tracked less closely with the processor types, possibly indicating cost/design trade-offs at play in these lower-cost systems. A fair number of 486DX/33 systems had slower memory scores than many of the 486SX/25 systems. Amax and MS Engineering have efficient DRAM subsystems, which helped their 486DX2/50 units perform well in cir-

cumstances where external-cache misses are prevalent. Compaq's unit does not include an external cache, but it does have a very fast DRAM subsystem that compensates somewhat.

DOS VIDEO

Again the units based on the Tseng ET4000 local bus performed best on our direct video write tests, and CompuAdd Express's local-bus unit took top billing, with an impressive score of 10.145 million operations per second. We counted 12 systems with local-bus video, of which 8 used Tseng chips. Systems based on the S3 86C924 and 86C911 Windows graphics accelerator chips continued to dominate the low end of the performance scale. The Telemart and Hewitt Rand units (with Trident TVGA chips) and the Micro Express, Standard, Amax, Gecco, and Keydata units (with the ATI Graphics Ultra) did not fare well in DOS video performance.

The Hyundai and Comtrade systems contained the new 32-bit S3 chip (86C805) in a local-bus design, and both achieved DOS video scores that were among the top 15 (they were also first and second, respectively, in Graphics Winmark scores). The top eight performers—the units from CompuAdd Express, Data Storage, NETiS, Altec, DFI, International Instrumentation (Blue Max Monolith 4250 DIUL), Mega, and Mitsuba—all featured Tseng-based local-bus video designs.

DOS DISK

Hardware disk caches were installed in all of the top ten performers. The first-place Diamond system used a 213MB Maxtor 7213AT IDE drive with a 2.5MB Promise Technology DC-99M hardware caching adapter, and it scored 91.26 kilobytes per second. The second-place NETiS unit used the same disk hardware but with only 2MB on the adapter.

Although none of the systems with-

out hardware caches performed exceptionally well, those with ISA-based IDE adapters generally outperformed those with IDE interfaces integrated on the motherboard.

Units that used the UltraStor 15C IDE caching adapter (those from ACMA, C², and International Instrumentation) had disappointing DOS Disk scores. In fact, many systems without hardware cache performed better than the International Instrumentation unit, which was the best of the three.

DOSMARK

The DOSmark scores emphasize disk speed, which is the primary cause of performance bottlenecks in a DOS system. Of the 15 systems with top DOSmark scores, 14 were also in the top 15 in DOS disk scores.

You can see the importance of processor speed by looking at the CompuAdd and IBM systems, which were not in the bottom five in disk performance but wound up with DOSmark scores among the bottom five because of their slower processors. The C² system took a double beating, because it used the UltraStor adapter and the last-place Cyrix Cx486SLC/25 chip.

GRAPHICS WINMARK

Users expecting mediocre graphics performance under Windows in systems that cost less than \$2,000 will be pleasantly surprised. Not only do 30 systems include graphics acceleration hardware, but some include the latest offerings from S3, and 12 have local-bus designs. The Tseng ET4000-based units were in the cellar in terms of Graphics Winmark scores. The Western Digital WD90C31 chip present in many systems delivered scores that were well above average.

The top-performing Hyundai (11.42 megapixels per second) incorporates the new STB PowerGraph VL-24 board in a VESA local-bus slot. The STB card houses the fast new S3

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—PC Magazine, January 26, 1993

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■	■	■	■	■	■	■	■	■	■	■	■	■	■	\$1395	\$1495	\$1595	\$1695	\$1795
■	■	■	■	■	■	■	■	■	■	■	■	■	■	\$1895	\$1995	\$2095	\$2195	\$2295
■	■	■	■	■	■	■	■	■	■	■	■	■	■	\$2195	\$2295	\$2395	\$2495	\$2595
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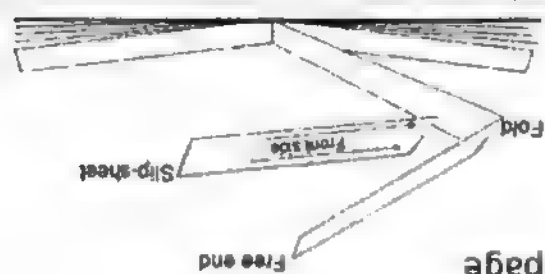
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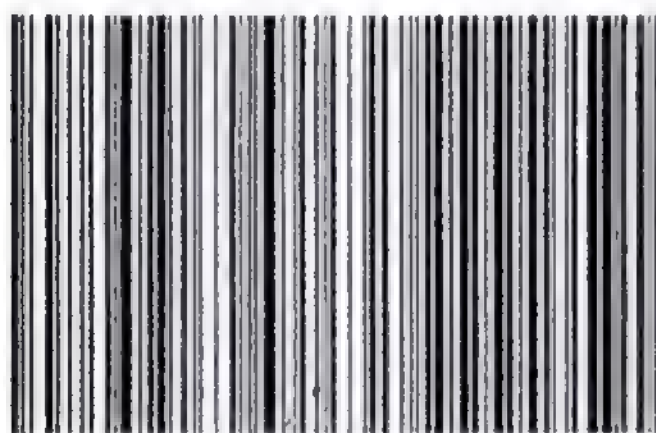
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Back

1. Follow instructions on the other side

Everybody is talking price, price, price. Now ZEOS is talking price, price, price and features, features, features! Right now, you get more features at lower prices from ZEOS than from anyone else. Compare for yourself.

CHOOSE FROM FOUR MONEY-SAVING PACKAGES. Or we can custom-build a system to your exact specifications. Just call us!

	Intel 486 CPU	ZIF upgrade socket	MB of RAM expandable to 64MB on motherboard	High-speed IDE hard drive (MB)	Built-in hard drive cache	Local bus IDE hard drive interface	Seek time (ms)	1.2MB Teac floppy drive	1.44MB Teac floppy drive	ZEOS 14" high-resolution mono VGA monitor	ZEOS 14" high-resolution 1024x768 non-interlaced monitor	Monitor dot pitch (mm)	1MB high-speed VESA local bus card	Eight expansion slots including two VESA local bus	Two serial ports
Package #1	■	■	2	85	32K	16	■	■	■	■	.28	■	■	■	■
Package #2	■	■	4	130	32K	16	■	■	■	■	.28	■	■	■	■
Package #3	■	■	8	245	128K	12	■	■	■	■	.28	■	■	■	■
Package #4	■	■	16	340	256K	12	■	■	■	■	.28	■	■	■	■

If you're going to invest in a new computer, naturally you want the best possible price. You also want the best possible computer. That's exactly what ZEOS gets you. Right now!

TAKE A REALLY CLOSE LOOK AT WHAT YOU GET:

■ VESA-standard local bus video—the *fastest video performance* available anywhere. *PC Magazine* said the ZEOS 486DX2-66 "shattered our previous record... by nearly fourfold." Now the dazzling video performance that rated #1 with *PC Magazine* can be yours!

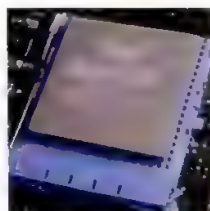


■ Local bus IDE hard drives. Now we've made your hard disk drive data throughput *over twice as fast with local bus IDE!* Dell doesn't have it; few others do either. ZEOS does. You do.

■ You get eight expansion slots, including two that support VESA-standard local bus devices with bus mastering. *Expandability with local bus performance in mind!*

■ ZIF (Zero Insertion Force) CPU upgradability from the 486SX-25 right through to the 486DX2-66 and, in the future, Intel's Pentium™-based OverDrive™ processor. According to *PC Magazine*, a system that can accommodate Intel's future generations of processors "is an advantage that you are

Nobody gives as ZEOS®. At



likely to appreciate..." Gateway doesn't have it. ZEOS does. You do.

■ Twin cooling fans. A ZEOS quality extra to help *protect your long-term investment*. One cooling fan just isn't enough to cool any modern PC, particularly at such high speeds. That's why ZEOS gives you two.

■ "An array of features to make a user's mouth water." —*PC Magazine*. Such as stronger cases, high-capacity power supplies with built-in surge suppression, floppy drives by Teac, and so much more.

■ Award-winning 24-Hour-A-Day Toll-Free Technical Support. We were the first to offer 24 hour support—years ago. Even now, few offer it 'round the clock. But with ZEOS you get it, 365 days a year.



When You Need Your Computer Yesterday,



Call ZEOS Today.



SAME-DAY SHIPPING ON OUR MOST POPULAR CONFIGURATIONS!

We know what it's like out there. Impossible deadlines. Decisions made in nano-seconds. Timetables so crazy they could make grown men weep.

So ZEOS has created a special program called *Computers Now!*™ With *Computers Now!* you get same-day shipping on our most popular configurations—both desktops *and* notebooks! It's a ZEOS exclusive, just for busy customers like you. And we've designed it to work the way you do: FAST.

HERE'S HOW IT WORKS:

Many, many popularly-configured ZEOS systems are pre-built and ready to ship. While supplies last, we'll ship your system to you the day you order subject to these conditions:

- 1.) Your order must be received by 1PM Central Time M-F.
- 2.) Credit cards are subject to authorization.
- 3.) Orders must be for ZEOS *Computers Now!* configurations. Call for details. Any other ZEOS systems and custom configurations take slightly longer.

OUR GUARANTEE TO YOU:

If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready.

This offer is good only as long as these pre-built systems are in stock, so give us a call to verify availability. This offer is limited to *Computers Now!* configurations.

IMMEDIATE SHIPMENT IS ONLY PART OF THE STORY.

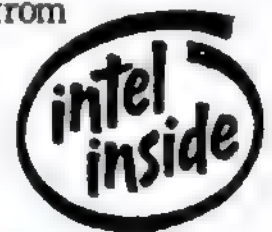
Computers Now! systems aren't just any computer systems. They're high-performance, high-quality ZEOS systems. Packing all the ZEOS value that's won *PC Magazine Editors' Choice*—*nine times!*

So give us a call right now. If we hear from you by 1:00 this afternoon, we'll get your new system on the way to you today!

ORDER NOW TOLL FREE

800-554-7172

Fax Orders: 612-633-1325, Government: 800-245-2449,
TDD Orders: 800-228-5389, Outside U.S. and Canada:
612-633-6131. MasterCard, VISA, Am Exp, Discover,
Z-Card, COD and Leasing programs.
Open 24 Hours a Day, 365 Days a Year!

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A. YOUR PERSONAL INFORMATION

Please complete all appropriate sections, *providing at least two years residence and employment history. THIS IS NOT A CREDIT AGREEMENT!* One will be sent to you upon authorization of an account. (This form must be signed to process your application.) All financed purchases are subject to credit approval. *If you have any credit questions, please call 800-421-8942 for assistance.* Thank you!

Name _____ Previous Address _____
 Home Phone (____) _____ City _____ State _____ Zip _____
 Soc. Sec. No. _____ Date of Birth ____/____/____ Employer _____ Since? (Mo./Yr.) _____
 Address _____ Apt. _____ Monthly Gross Salary \$ _____ Daytime Bus. Phone (____) _____
 City _____ State _____ Zip _____ Previous Employer _____ From _____ To _____
 Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____ Occupation _____

A married person may apply for individual credit. I am applying for (please check appropriate box):

☐ **JOINT CREDIT** with another person. Complete entire application.

☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.

☐ **INDIVIDUAL CREDIT**. Do not complete section C. **

** If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

NOTICE TO WISCONSIN APPLICANTS:
 YOU MUST DISCLOSE YOUR MARITAL STATUS
☐ married ☐ unmarried ☐ legally separated

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying this obligation.

Additional Monthly Income \$ _____ Source _____

Name & Address of Nearest Relative Not Living With You _____

Relationship _____

B. CREDIT INFORMATION

PLEASE TELL US IF YOU HAVE A:

Checking Account	☐ Yes ☐ No		
Savings Account	☐ Yes ☐ No		
Y/N	How Many?	Y/N	How Many?
Bank Loan	_____	Dept. Store Charge Card	_____
VISA	_____	Credit Union Account	_____
MasterCard	_____	Other Major Charge Cards	_____
Finance Company Loan	_____		

C. JOINT APPLICANT INFORMATION

Joint Applicant's Name _____

Soc. Sec. No. _____ Date of Birth _____

Address _____ Apt. _____

City _____ State _____ Zip _____

Home Phone (____) _____ Date of Residence (Mo./Yr.) _____

Joint Applicant's Employer _____ Since? (Mo./Yr.) _____

Bus. Phone (____) _____ Monthly Gross Salary \$ _____

CUSTOMER AUTHORIZATION

I authorize ZEOS International, Ltd. or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct to the best of my knowledge and belief.

Applicant's Signature _____ Date _____

Joint Applicant's Signature _____ Date _____

FOR MARRIED WISCONSIN APPLICANTS I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

Buyer's Signature _____ Date _____

There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 800-421-8942 or write to ZEOS, Z-Card Processing Center, 1301 Industrial Blvd., Minneapolis, MN 55413.

NY—A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

OH—The Ohio laws against discrimination require that all creditors make credit equally available to all creditworthy customers and that credit reporting agencies maintain separate credit histories on each individual upon request. The Ohio Civil Rights Commission administers compliance with this law.

* Financing not available in Alaska, Hawaii or outside the continental U.S.

ZCD-PCM-9302B

Z-CARD PRIORITY APPLICATION FAX NUMBER: 612-633-7507

CIRCLE 115 ON READER SERVICE CARD

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Z-Card 
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YOUR NAME HERE

EXP 01/94

Here's another great reason to buy a ZEOS system: the Z-Card™! The Z-Card works just like a MasterCard or VISA—so you can charge your ZEOS purchases and pay in easy monthly installments. And since no down payment is required, it makes buying your new ZEOS system easier than ever!

You can apply for your very own Z-Card and low, low monthly payments right now. Simply fill out this application and fax it to 612-633-7507. Or mail it to **ZEOS International, Z-Card Processing Center, 1301 Industrial Blvd., Minneapolis, MN 55413**. We'll contact you as soon as your credit line is established, usually within 24 hours of receipt. Apply today!



Benchmark Tests: Low-Cost PCs

CONTINUES

86C805 32-bit Windows graphics accelerator chip. Close behind, with the same video adapter in a proprietary local-bus slot, was the Comtrade unit, scoring 11.32 megapixels per second.

DISK WINMARK

Disk Winmark scores are influenced by the presence of SmartDrive. We installed a 1MB SmartDrive cache with write-back enabled in all systems. The Expo unit achieved first place, with a score of 41.77 kilobytes per second.

As expected, we saw several systems where hardware caches conflicted with SmartDrive. The top five Disk Winmark units did not have hardware caching adapters. The slowest performers were systems based on UltraStor 15C caching adapters; these were slow with or without SmartDrive.

HOW WE TESTED

In preparing this issue, we used PC Magazine Labs' Hardware Benchmark Tests, Release 7.0, to predict PC processor, memory, video subsystem, and disk performance using DOS applications. Each of the four scores we report is the weighted harmonic mean of the results from several tests, expressed in terms of throughput or operations per second. These results are summarized in a composite score called the DOSmark.

We also used the Windows Benchmark Tests (Winbench), Release 3.1, to obtain the Graphics Winmark and Disk Winmark scores, which predict the relative performance levels using popular Windows applications.

The **processor** score is a measure of the CPU's performance and its interaction with cache and main memory. It is derived from tests that use small and medium-size instruction mixes, along with either the floating-point calculation test or the coprocessor test (depending on the presence or absence of a math coprocessor). The score indicates how well a computer's CPU and cache subsystems would execute common DOS and Windows applications.

The **memory** score is compiled from 8-, 16-, and 32-bit extended-memory read and write tests, as well as 8- and 16-bit conventional-memory read and write tests. Taken together, these tests reflect the throughput of a computer's main memory.

The **disk** score measures throughput using standard DOS INT 21h file I/O calls. The tests measure the speed of file reading and writing, both sequentially and randomly, for a range of file sizes from 256K to 32MB. The tests are performed without software disk caches installed.

The **video** score is based on direct-to-screen text-write and graphics-write tests. Taken together, these tests reflect the video throughput for a standard EGA/VGA adapter running DOS applications.

The **DOSmark** score is a composite rating derived from the processor, memory, video, and disk scores. The DOSmark indicates a PC's ability to run DOS applications.

The **Graphics Winmark** score is based on 12 Windows graphics and text functions derived from extensive profiling of popular Windows applications. It is measured in megapixels per second (a megapixel is 1,048,576 pixels).

The **Disk Winmark** score is based on testing techniques adapted from the DOS disk tests to reflect operations within the Windows environment. For this portion of the testing, the systems were configured with up to 2MB of SmartDrive cache.

PROCESSOR

Operations per second	0	3,000	6,000	9,000	12,000	
Acer Acros 486SX/25						6,017.78
ACMA 486/33						8,908.06
AGA DX33 (486DX/33)						8,785.58
ALR Flyer RS170 4/25s (486SX/25)						6,353.36
Altrec 486/33 ISA Local Bus						8,900.17
Amax 486DX2/50 ISAmix Power Station						12,898.81
American Mitac D4033 (486DX/33)						8,785.46
American Super Computer ASC 486/33						9,212.58
Ares 486 25SX Vt. Bus						5,890.16
Ariel 486SX 25 Best Value						5,953.38
Austin 486 DX2 50 WinStation						13,072.30
BCR 486DX/33						12,198.04
C' Saber 486/SLC (C486SLC/25)						2,298.70
Clover 486 SX (486SX/25)						5,751.42
Cornex 486SX/25 VESA						6,895.35
Comp & Soft CS 486/33C256						8,868.42
Compaq ProLima 4/33 (486DX/33)						8,315.56
CompuAdd 425SLC Low Profile (C486SLC/25)						2,551.52
CompuAdd Express 440DLC (C486DLC/40)						8,536.06
Comtrade 486 VESA WinStation (486DX/33)						8,863.35
DataStor 486 25SX						6,939.97
Delt System 486P/25 (486SX/25)						6,098.97
DFI Diamond Series Model 425SA (486SX/25)						6,313.71
Diamond DT 486DLC/40 (C486DLC/40)						7,746.88
Digital DECpc 333sx LP (Am486SX/XL-33)						4,341.33
DTK FEAT 3300 (486DX/33)						9,257.27
Expo 486DX2/50						12,148.14
FastData 486/33+						8,749.84
Gateway 2000 4DX 33 (486DX/33)						6,922.87
Gecco 4DX 33 (486DX/33)						9,275.95
Hewlett Rand HR 486SX 25C						6,154.89
HP Vectra 486/25N (486SX/25)						5,791.35
HiQ Ultimate 4331 (486DX/33)						9,293.42
Hyundai 433S (486SX/33)						8,694.14
IBM PS/1 2155 G44 (486SX/20)						4,462.34
Image 486DX 33						9,061.61
Insight 486-33 Cache						9,039.78
Blue Max Monolith 4250 DIUL (486DX2/50)						12,208.29
KEY486 33 ISA						8,998.51
LodeStar 486DLC-33 (C486DLC/33)						7,308.95
Mega Impact 486SX/25+						6,676.38
MicroFLEX 486/DX2/50						12,538.20
Mitsuba ProComp/adapt45SX/25 (486SX/25)						6,735.71
MSE 486EISA 50MHz (486DX2/50)						12,561.40
Flash 486DX2-50 LB						12,036.81
NCR System 3230 (486SX/25)						6,925.14
NFC Ready 425 System (486SX/25)						8,069.57
NETS Ultra WinStation N433L (486DX/33)						8,558.15
Occidental 33MHz 486DX						8,147.18
PC Brand Leader 486/DLC 33 (C486DLC/33)						6,811.34
Poly 486 50 (486DX2/50)						12,864.75
QSI Konimus 486 SX25						6,853.75
Qtech PC-4033 4 (486DX/33)						8,796.20
SST 386/40 MWT (Am386DX, 40)						6,381.69
Standard 486SX/25						6,890.65
Swan 486SX/25 V						6,546.72
Telemart MITS HSY 88 486DX 50						13,331.87
Tanex Premier 486DX/33						9,257.23
Unitex UT 486DX50C						13,445.88
USA Flex 486DX 33MHz System						8,961.88
ZDS Z-425SX Model 200 (486SX/25)						6,212.91

WORST

BEST



Benchmark Tests: Low-Cost PCs

CONTINUES

MEMORY

kilobytes per second	0	2,000	4,000	6,000	
Acer Arcos 486SX/25					4,256.76
ACMA 486/33					5,553.85
AGA-DX33 486DX/33					4,633.77
ALR Flyer RS170 4/25s (486SX/25)					4,381.14
Altos 486/33 (486SX/33)					4,232.93
Amax 486DX2 50 (Amax Power Station)					7,651.94
American Mitac D4033 (486DX/33)					4,630.94
American Super Computer ASC 486/33					5,097.53
Ares 486/33 (486SX/33)					3,561.59
Arise 486/33 (486SX/33) Best Value					3,874.29
Austin 486/DX2 50 WinStation					5,198.17
BSI 486DX2 50					2,526.63
C-Saber 486/SXC (C486SLC/25)					3,526.93
Clover 486/SXC (486SX/25)					4,235.46
Comex 486SX/25 VESA					3,568.21
Comp & Soft CS-486/33C256					5,131.70
Compaq ProLinea 4/33 (486DX/33)					5,829.31
CompuAdd 425SLC Low Profile (C486SLC/25)					3,512.31
CompuAdd Express 440DLC (C486DLC/40)					4,240.02
CompuAdd Express 440 VESA WinStation (486DX/33)					3,665.78
Conquest 486/33 (486SX/33)					4,242.42
Cyber 486/33 (486SX/33)					4,249.64
DI Grammel Series Model 425SA (486SX/25)					4,336.44
Diamond DT 486DLC 40 (C486DLC/40)					5,408.25
Digital DECpc 333sx LP (Am486SX/XL 33)					3,301.17
DTK FEAT 3300 (486DX/33)					5,427.15
Expo 486DX2/50					5,501.94
FastData 486/33+					3,679.96
Gateway 2000 4DX-33 (486DX/33)					5,216.19
Gecco 4DX 33 (486DX/33)					4,647.76
Hewlett Rand HR 486SX 25C					3,900.12
HP Vectra 486/25N (486SX/25)					3,804.83
HiQ Ultimate 433i (486DX/33)					4,728.30
Hyundai 433S (486SX/33)					4,670.46
IBM PS/1 2155-G44 (486SX/20)					2,940.28
Image 486DX-33					2,921.36
Insight 486 33i Cache					4,550.65
Blue Max Monolith 4250 DIUL (486DX2/50)					3,839.19
KEY486-33 ISA					5,606.88
LodeStar 486DLC 33 (C486DLC/33)					4,242.44
Mega Impact 486SX/25+					3,441.39
MicroFLEX 486-DX2/50					6,183.49
Mitsuba Pro Upgradable4SX/25 (486SX/25)					3,619.36
MSE 486EISA 50MHz (486DX2/50)					7,530.87
Flash 486DX2 50 LB					3,854.34
NCR System 3230 (486SX/25)					3,928.12
NEC Ready 425 System (486SX/25)					3,800.87
NET/S Ultra WinStation N433L (486DX/33)					4,228.42
Occidental 33MHz 486DX					2,831.16
PC Brand Leader 486/DLC-33 (C486DLC/33)					4,647.95
Poly 486 50i (486DX2/50)					4,956.61
QSI Klonimus 486 SX25					3,192.49
Otech PC 4033 4 (486DX/33)					3,347.46
SST 386-40 MWC (Am386DX/40)					4,757.98
Standard 486SX/25					4,550.95
Swan 486/33 (486SX/33)					2,971.00
Telemart MITS HSY 88-486DX 50					5,205.34
Tenex Premier 486DX/33					5,135.37
Unitek UT 486C 350P					5,673.25
USA Flex 486DX 33MHz System					3,756.20
ZDS Z 425SX Model 200 (486SX/25)					4,373.65

WORST

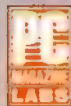
BEST

VIDEO

Thousands of operations per second	0	3,000	6,000	9,000	
Acer Arcos 486SX/25					3,666.81
ACMA 486/33					2,475.37
AGA-DX33 (486DX/33)					3,734.81
ALR Flyer RS170 4/25s (486SX/25)					4,876.99
Altos 486/33 (486SX/33)					8,533.52
Amax 486DX2/50 ISAMax Power Station					2,200.63
American Mitac D4033 (486DX/33)					3,099.46
American Super Computer ASC 486/33					3,106.04
Ares 486-25SX VL-Bus					3,660.97
Anel 486SX 25 Best Value					4,813.26
Austin 486/DX2 50 WinStation					2,364.18
BSI 486DX2 50					3,420.48
C-Saber 486/SXC (C486SLC/25)					3,226.90
Clover 486/SXC (486SX/25)					3,075.71
Comex 486SX/25 VESA					6,618.54
Comp & Soft CS 486/33C256					2,250.95
Compaq ProLinea 4/33 (486DX/33)					4,303.73
CompuAdd 425SLC Low Profile (C486SLC/25)					3,514.28
CompuAdd Express 440DLC (C486DLC/40)					10,145.21
CompuAdd Express 440 VESA WinStation (486DX/33)					6,750.74
Conquest 486/33 (486SX/33)					9,178.70
Cyber 486/33 (486SX/33)					4,333.14
DI Grammel Series Model 425SA (486SX/25)					8,356.02
Diamond DT 486DLC 40 (C486DLC/40)					1,943.13
Digital DECpc 333sx LP (Am486SX/XL 33)					4,171.48
DTK FEAT-3300 (486DX/33)					4,022.56
Expo 486DX2/50					3,989.84
FastData 486/33+					3,396.57
Gateway 2000 4DX-33 (486DX/33)					6,041.48
Gecco 4DX 33 (486DX/33)					2,359.32
Hewlett Rand HR 486SX 25C					1,551.40
HP Vectra 486/25N (486SX/25)					1,783.35
HiQ Ultimate 433i (486DX/33)					4,964.97
Hyundai 433S (486SX/33)					6,506.99
IBM PS/1 2155-G44 (486SX/20)					3,187.33
Image 486DX-33					5,059.71
Insight 486 33i Cache					4,986.75
Blue Max Monolith 4250 DIUL (486DX2/50)					8,048.51
KEY486-33 ISA					2,446.87
LodeStar 486DLC 33 (C486DLC/33)					4,647.37
Mega Impact 486SX/25+					7,884.40
MicroFLEX 486-DX2/50					1,713.46
Mitsuba Pro Upgradable4SX/25 (486SX/25)					7,206.27
MSE 486EISA 50MHz (486DX2/50)					3,327.86
Flash 486DX2 50 LB					1,721.61
NCR System 3230 (486SX/25)					3,563.31
NEC Ready 425 System (486SX/25)					3,412.48
NET/S Ultra WinStation N433L (486DX/33)					8,744.85
Occidental 33MHz 486DX					3,904.98
PC Brand Leader 486/DLC-33 (C486DLC/33)					4,082.79
Poly 486 50i (486DX2/50)					4,640.33
QSI Klonimus 486 SX25					1,632.74
Otech PC 4033 4 (486DX/33)					4,127.01
SST 386-40 MWC (Am386DX/40)					1,218.72
Standard 486SX/25					2,173.92
Swan 486/33 (486SX/33)					1,755.86
Telemart MITS HSY 88-486DX 50					1,288.41
Tenex Premier 486DX/33					3,174.79
Unitek UT 486DX50C					3,432.97
USA Flex 486DX 33MHz System					1,764.24
ZDS Z 425SX Model 200 (486SX/25)					3,828.33

WORST

BEST



Benchmark Tests: Low-Cost PCs

CONTINUES

DISK

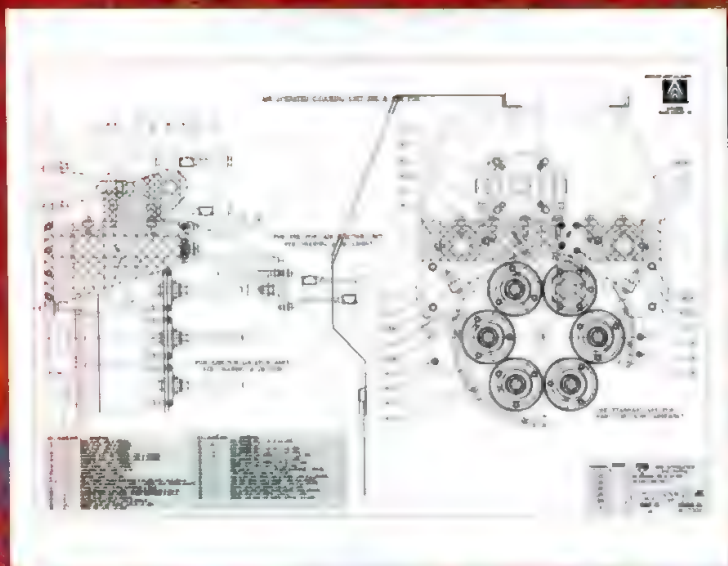
k/bytes per second	0	20	40	60	80	
Acer Acros 486SX/25						27.25
ACMA 486-33						21.74
AGA-DX33 (486DX/33)						32.48
ALR Flyer R4170 4/25s (486SX/25)						25.48
Altec 486-33 ISA Local Bus						28.15
Amax 486DX/50 ISAmax Power Station						67.78
American Mirror D403s 486DX/33						32.48
American Super Computer ASC 486/33						31.25
Ares 486-25SX VL Bus						21.80
Ariel 486SX-25 Best Value						18.88
Austin 486/DX2-50 WinStation						35.37
BSI 486DX2/50						28.42
C-Saber 486/SLC (C486SLC/25)						28.88
Clover 486-SXC (486SX/25)						27.97
Comex 486SX/25 VESA						21.83
Comp & Soft Co 486/33C756						28.71
Compaq Prolinea 4-33 (486DX/33)						34.99
CompuAdd 425SLC Low Profile (C486SLC/25)						25.47
CompuAdd Express 440DLC (C486DLC/40)						24.76
Comtrade 486 VESA WinStation (486DX/33)						35.23
DataStor 486-25SX						27.83
Deft System 486P/25 (486SX/25)						25.87
DFI Diamond Series Model 425SA (486SX/25)						27.72
Diamond DT 486DLC-40 (C486DLC/40)						91.26
Digital DECpc 333sx LP (Am486SX/XL 33)						38.95
Dix Flat 330L 486DX/33						28.73
Expo 486DX2/50						38.13
FastData 486-33+						32.10
Gateway 2060-40X-33 (486DX/33)						58.80
Genex 4DX-33 (486DX/33)						33.88
Hewlett-Packard HP 486SX-25C						34.11
HP Vectra 486-25N (486SX/25)						21.82
Hyperimate 4331 (486DX/33)						48.83
Hyundai 433S (486SX/33)						27.46
IBM PS/1 2155 (344/486SX/20)						25.67
Image 486DX-33						28.86
Insight 486-33 Cache						34.16
Blue Max Monolith 4250 DIUL (486DX2/50)						31.53
KEY486-33 ISA						28.63
LeaderStar 486DX/33 (C486DLC/33)						48.73
Mega Impact 486SX/25+						25.53
MicroFLX 486/DX2/50						47.74
Mitsuba Pro Upgradeable 486SX/25 (486SX/25)						61.94
MSE 486EISA-50MHz (486DX2/50)						28.27
Flash 486DX2-50 LB						63.13
NCR System 3230 (486SX/25)						25.91
NEC Ready 425 System (486SX/25)						28.94
NET/S Ultra WinStation N433L (486DX/33)						98.83
Occidental 33MHz 486DX						24.94
PC Brand Leader 486/DLC-33 (C486DLC/33)						34.42
Poly 486-50 (486DX2/50)						58.21
OSI Klonimus 486/SX25						33.97
Qtech PC 4D33-4 (486DX/33)						27.88
SST 486-40 MWC (Am386DX/40)						38.73
Standard 486SX/25						28.78
Swan 486SX-25 V						27.12
Tekman MT15 HSY 88 486DX-50						28.86
Tetrex Premier 486DX/33						34.80
Unitek UT-486DX50C						35.43
USA Flex 486DX 33MHz System						34.15
ZDS Z 425SX Model 200 (486SX/25)						33.71
	WORST				BEST	

DOSMARK

	0	20	40	
Acer Acros 486DX/25				24.16
ACMA 486-33				23.78
AGA-DX33 (486DX/33)				28.74
ALR Flyer RS170 4/25s (486SX/25)				23.73
Altec 486/33 ISA Local Bus				27.83
Amax 486DX/50 ISAmax Power Station				53.29
American Mirror D403s 486DX/33				28.88
American Super Computer ASC 486-33				28.87
Ares 486-25SX VL Bus				28.54
Ariel 486SX-25 Best Value				19.85
Austin 486-DX2-50 WinStation				34.87
BSI 486DX2/50				25.94
C-Saber 486/SLC (C486SLC/25)				18.14
Clover 486-SXC (486SX/25)				23.72
Comex 486SX/25 VESA				21.43
Comp & Soft Co 486-33C756				28.10
Compaq Prolinea 4-33 (486DX/33)				31.85
CompuAdd 425SLC Low Profile (C486SLC/25)				16.81
CompuAdd Express 440DLC (C486DLC/40)				24.83
Comtrade 486 VESA WinStation (486DX/33)				28.75
DataStor 486-25SX				25.51
Deft System 486P/25 (486SX/25)				23.15
DFI Diamond Series Model 425SA (486SX/25)				17.24
Diamond DT 486DLC-40 (C486DLC/40)				46.47
Digital DECpc 333sx LP (Am486SX/XL 33)				22.85
DTK FEAT 330L 486DX/33				28.74
Expo 486DX2/50				35.29
FastData 486-33+				32.16
Gateway 2060-40X-33 (486DX/33)				37.78
Genex 4DX-33 (486DX/33)				38.25
Hewlett-Packard HP 486SX-25C				26.72
HP Vectra 486-25N (486SX/25)				28.88
Hyperimate 4331 (486DX/33)				37.88
Hyundai 433S (486SX/33)				27.85
IBM PS/1 2155 (344/486SX/20)				28.84
Image 486DX-33				25.80
Insight 486-33 Cache				38.75
Blue Max Monolith 4250 DIUL (486DX2/50)				38.28
KEY486-33 ISA				28.55
LeaderStar 486DX/33 (C486DLC/33)				34.34
Mega Impact 486SX/25+				23.88
MicroFLX 486/DX2/50				42.11
Mitsuba Pro Upgradeable 486SX/25 (486SX/25)				38.43
MSE 486EISA-50MHz (486DX2/50)				31.57
Flash 486DX2-50 LB				42.35
NCR System 3230 (486SX/25)				23.81
NEC Ready 425 System (486SX/25)				23.58
NET/S Ultra WinStation N433L (486DX/33)				45.86
Occidental 33MHz 486DX				22.74
PC Brand Leader 486/DLC-33 (C486DLC/33)				28.72
Poly 486-50 (486DX2/50)				41.82
OSI Klonimus 486/SX25				25.38
Qtech PC 4D33-4 (486DX/33)				25.40
SST 386-40 MWC (Am386DX/40)				26.33
Standard 486SX/25				24.88
Swan 486SX-25 V				22.88
Tekman MT15 HSY 88 486DX-50				38.48
Tetrex Premier 486DX/33				31.88
Unitek UT-486-X50C				35.58
USA Flex 486DX 33MHz System				28.20
ZDS Z 425SX Model 200 (486SX/25)				27.42
	WORST			BEST

ProTracer. Where the qualities of a laser printer meet the output of a large format plotter.

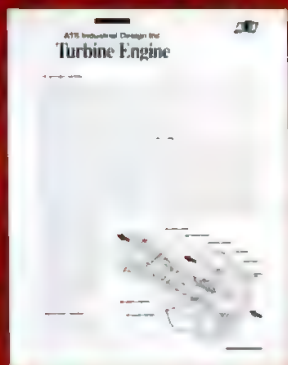
C-size (17" x 22")



B-size (11" x 17")



A-size (8.5" x 11")



Laser printers offer so much.

Like high quality output, speed, desktop convenience and, of course, a low price. Large format plotters, on the other hand, give you the output size you need for certain drawings and applications. What we've done is pulled all of these features together to create ProTracer™ — a personal printer and plotter that produces A, B, and C-size output at an impressive 360 dpi resolution.

FEATURES INCLUDE:

- ▶ High performance Canon® inkjet engine
- ▶ Fast, Intel i960™ processor—drawings that take over one half hour on pen plotters take as little as five minutes on ProTracer!
- ▶ Optional accessories including a new, faster HP-GL® language emulation card, PostScript® language emulation, memory expansion boards, and sheet feeders
- ▶ Full vellum capabilities
- ▶ Unsurpassed customer service — 60-day money back guarantee, one year warranty, and unlimited technical support

ProTracer base unit

- ▶ Customized ADI and PADI drivers for AutoCAD users
- ▶ Epson and ProPrinter emulations

\$1499

ProTracer with HP-GL

- ▶ ProTracer base unit
- ▶ HP-GL emulation card plus memory

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ProTracer with PostScript emulation

- ▶ ProTracer base unit
- ▶ PostScript language emulation card
- ▶ 8 MB memory

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Benchmark Tests: Low-Cost PCs

ENDS

GRAPHICS WINMARK

Megapixels per second	0	3	6	9
Acer Acros 486SX/25				
ACMA 486/33				
AGA-DX33 (486DX/33)				
ALR Flyer RS170 4/25s (486SX/25)				
Altrec 486/33 ISA Local Bus				
Amax 486DX2/50 ISAmix Power Station				
American Mitac D4033 (486DX/33)				
American Super Computer ASC 486/33				
Ares 486-25SX VL Bus				
Ariel 486SX 25 Best Value				
Austin 486 DX2 50 WinStation				
BSI 486DX2/50				
C. Saber 486/SLC (C486SLC/25)				
Clover 486-SXC (486SX/25)				
Comex 486SX/25 VESA				
Comp & Soft CS 486/33C256				
Compaq ProLinea 4/33 (486DX/33)				
CompuAdd 425SLC Low Profile (C486SLC/25)				
CompuAdd Express 440DLC (C486DLC/40)				
Comtrade 486 VESA WinStation (486DX/33)				
DataStor 486-25SX				
Dell System 486P/25 (486SX/25)				
DFI Diamond Series Model 425SA (486SX/25)				
Diamond DT 486DLC-40 (C486DLC/40)				
Digital DECpc 333sx LP (Am486SX/XL-33)				
DTK FEAT. 3300 (486DX/33)				
Expo 486DX2/50				
FastData 486/33+				
Gateway 2000 4DX 33 (486DX/33)				
Gecco 4DX 33 (486DX/33)				
Hewlett Rand HR 486SX 25C				
HP Vectra 486 25N (486SX/25)				
HiQ Ultimate 433 (486DX/33)				
Hyundai 433S (486SX/33)				
IBM PS-1 2155-G44 (486SX/20)				
Image 486DX 33				
Insight 486-33i Cache				
Blue Max Monolith 4250 DIUL (486DX2/50)				
KEY-486-33 ISA				
LodeStar 486DLC-33 (C486DLC/33)				
Mega Impact 486SX/25+				
MicroFLEX 486 DX2/50				
Mitsuba Pro Upgradable4SX/25 (486SX/25)				
MSE 486EISA 50MHz (486DX2/50)				
Flash 486DX2 50 LB				
NCR System 3230 (486SX/25)				
NEC Ready 425 System (486SX/25)				
NET/S Ultra WinStation N433L (486DX/33)				
Occidental 33MHz 486DX				
PC Brand Leader 486/DLC-33 (C486DLC/33)				
Poly 486-50i (486DX2/50)				
QSI Kionimus 486-SX25				
Qtech PC-4033 4 (486DX/33)				
SST 386 40 MWC (Am386DX/40)				
Standard 486SX/25				
Swan 486SX/25 V				
Telemart MITS HSY-88-486DX 50				
Tenex Premier 486DX/33				
Unitex UT-486DX50C				
USA Flex 486DX-33MHz System				
ZDS Z-425SX Model 200 (486SX/25)				
	WORST			BEST

DISK WINMARK

Kilobytes per second	0	10	20	30	40
Acer Acros 486SX/25					
ACMA 486/33					
AGA-DX33 (486DX/33)					
ALR Flyer RS170 4/25s (486SX/25)					
Altrec 486/33 ISA Local Bus					
Amax 486DX2/50 ISAmix Power Station					
American Mitac D4033 (486DX/33)					
American Super Computer ASC 486/33					
Ares 486 25SX VL-Bus					
Ariel 486SX 25 Best Value					
Austin 486 DX2 50 WinStation					
BSI 486DX2/50					
C. Saber 486-SXC (C486SLC/25)					
Clover 486-SXC 486SX/25					
Comex 486SX 25 VESA					
Comp & Soft CS 486/33C256					
Compaq ProLinea 4/33 (486DX/33)					
CompuAdd 425SLC Low Profile (C486SLC/25)					
CompuAdd Express 440DLC (C486DLC/40)					
Comtrade 486 VESA WinStation (486DX/33)					
DataStor 486-25SX					
Dell System 486P/25 (486SX/25)					
DFI Diamond Series Model 425SA (486SX/25)					
Diamond DT 486DLC-40 (C486DLC/40)					
Digital DECpc 333sx LP (Am486SX/XL-33)					
DTK FEAT. 3300 (486DX/33)					
Expo 486DX2/50					
FastData 486/33+					
Gateway 2000 4DX 33 (486DX/33)					
Gecco 4DX 33 (486DX/33)					
Hewlett Rand HR 486SX 25C					
HP Vectra 486 25N (486SX/25)					
HiQ Ultimate 433 (486DX/33)					
Hyundai 433S (486SX/33)					
IBM PS-1 2155-G44 (486SX/20)					
Image 486DX 33					
Insight 486-33i Cache					
Blue Max Monolith 4250 DIUL (486DX2/50)					
KEY-486-33 ISA					
LodeStar 486DLC-33 (C486DLC/33)					
Mega Impact 486SX/25+					
MicroFLEX 486 DX2/50					
Mitsuba Pro Upgradable4SX/25 (486SX/25)					
MSE 486EISA 50MHz (486DX2/50)					
Flash 486DX2 50 LB					
NCR System 3230 (486SX/25)					
NEC Ready 425 System (486SX/25)					
NET/S Ultra WinStation N433L (486DX/33)					
Occidental 33MHz 486DX					
PC Brand Leader 486/DLC-33 (C486DLC/33)					
Poly 486-50i (486DX2/50)					
QSI Kionimus 486-SX25					
Qtech PC-4033 4 (486DX/33)					
SST 386 40 MWC (Am386DX/40)					
Standard 486SX/25					
Swan 486SX/25 V					
Telemart MITS HSY-88-486DX 50					
Tenex Premier 486DX/33					
Unitex UT-486DX50C					
USA Flex 486DX-33MHz System					
ZDS Z-425SX Model 200 (486SX/25)					
	WORST				BEST

OKIDATA USES 2,560 BURSTS OF LIGHT TO MAKE YOU LOOK BRILLIANT.



If you think all laser printers are mirror images of each other, meet the one that broke the mirror.

Okidata® engineers flatly rejected the complex mechanism of rotating mirrors, focusing lenses and whirring motors that every major brand of laser printer depends on for its operation. Instead, they designed a better way – a unique, solid-state LED printhead that precisely positions each one of 2,560 pinpoints of light, to produce a laser printer's brilliant output without a laser printer's built-in complications.

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Since our solid-state LED printhead has no moving parts, Okidata guarantees it for five full years – the industry's longest. (After all, our printers have a reputation of reliability to uphold.) And we offer a full range of machines that can handle any workload from basic word processing to sophisticated business text and graphics.*

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CIRCLE 056 ON READER SERVICE CARD

COVER STORY

Low-Cost PCs



FACT FILE

ALR Flyer RS170 4/25s

Advanced Logic Research Inc., 9401
Jeronimo, Irvine, CA 92718; 800-444-4257,
714-581-6770; fax, 714-581-9240

List price (tested configuration): \$1,848

Memory and processor RAM cache: 4MB 80-ns
SIMMs

Disk drives and controller: Conner CP30174E 17-
ms 170MB IDE hard disk with 32K cache, disk controller
integrated onto motherboard, 1.44MB floppy disk drive

Display: Video controller with 1MB DRAM integrated
onto motherboard, ALR FlexVIEW 3X 14-inch monitor
with a 56-Hz refresh rate at 800-by-600 noninterlaced
resolution

Software: None.

In short: The ALR Flyer RS170 4/25s produced average
to below-average performance on our benchmark tests,
and offers limited expansion potential, but its small
footprint is a plus.

501 ON READER SERVICE CARD

plications without huge storage needs. If
space is at a premium, and a quality de-
sign is important to your needs, the ALR
is definitely a fine choice.—BB

Altec Technology Corp.

Altec 486/33 ISA Local Bus

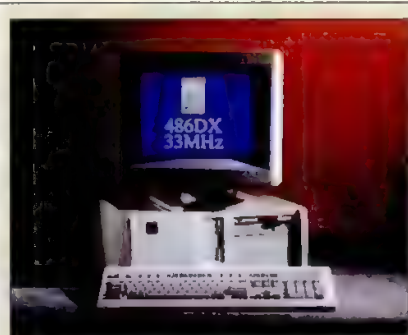
The \$1,929 Altec 486/33 ISA Local Bus
was a better-than-average performer on
PC Magazine Labs' benchmark tests, and
it has good expansion room, but if you
are interested in upgrading down the
road, the proprietary bus could be a
problem.

A year ago, the Altec's high-speed
proprietary local bus would have been
big news. With the VESA VL-bus stand-
ard, which is now widely accepted, the
Altec won't be able to take advantage of
future advances in high-performance

cards for the VESA-VL bus.

The Altec comes with a
proprietary Giga-Byte Tech-
nology local-bus video card
with 1MB of video RAM,
which performed exception-
ally well on the DOS video test
routines but produced a much
lower Graphics Winmark
score. If you wanted to up-
grade to a faster Windows video accelera-
tor local-bus card, this system's bus
wouldn't accept it. The Altec's DOSmark
score, which measures the computer's
performance across the four DOS-based
tests, failed to impress us.

The Altec's desktop case is nicely fin-
ished, with easy expansion access and five
drive bays. The 210MB Fuji hard disk
with a 64K cache and the KW 556F IDE
drive controller are unusual brand names
within the group we reviewed. The sys-



FACT FILE

Altec 486/33 ISA Local Bus

Altec Technology Corp., 1201 W. Foothill
Blvd., Azusa, CA 91702; 800-255-9971,
818-969-2988; fax, 818-969-1238

List price (tested configuration): \$1,929.

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 256K external cache

Disk drives and controller: Fuji FK317A-210R 13-
ms 210MB IDE hard disk with 64K cache, Kovtech
Systems KW 556F ISA card disk controller, 1.2MB and
1.44MB floppy disk drives.

Display: Giga-Byte Technology GA-200, proprietary lo-
cal-bus card video controller with 1MB DRAM, View-
Sonic 6E 14-inch monitor with a 60-Hz refresh rate at
1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: This \$1,929 PC's slightly above-average per-
formance and good expansion room is marred by a pro-
prietary bus that might make future upgrades difficult.

512 ON READER SERVICE CARD

Altec 486/33 ISA Local Bus

SUITABILITY TO TASK

DOS
applications **GOOD**

Windows
applications **GOOD**

Expandability **FAIR**

tem had an adequate Disk
Winmark score.

Using a 486DX/33 CPU
with 4MB of RAM and a 256K
external RAM cache, the
Altec achieved a score slightly
above average on the pro-
cessor test routines.

Altech Technology Corp.'s
decent warranty (which covers

parts for two years and labor for the life-
time of the computer) and its 800 techni-
cal support number help make this mail-
order system a secure choice. But take
a careful look at machines that support
the VESA VL-bus before jumping ahead
and buying the Altec.—BB

Amax Engineering Corp.

Amax 486DX2/50 ISAmix Power Station

With a \$1,995 price tag, Olympic-class
performance scores on PC Magazine
Labs' benchmark tests, spacious expan-
sion possibilities, and excellent compo-
nents, the Amax 486DX2/50 ISAmix
Power Station deserves a gold medal.

You'll certainly be impressed by the
full-size tower case. It holds eight drive
bays and a 250-watt power supply, and
you can easily expand this PC to your
heart's content. The tower case also
leaves you plenty of room to access the
motherboard, but with 4MB of RAM and
a 256K external SRAM cache already
installed, you won't need to access it very
much. If you want to upgrade your
processor, the motherboard is configura-
ble to any 486 pro-
cessor via jumper
settings.

The rest of the
board has the
capacity to be a
real powerhouse,
with a system
maximum of
64MB of RAM

on-board, a cached hard disk controller,
an ATI mouse, an ATI video controller
with 1MB of VRAM, and an excellent
MAG monitor with digital controls,
multiscanning presets, and support for
noninterlaced resolutions of up to 1,024-
by-768 at a 76-Hz refresh rate. All of this

Amax 486DX2/50 Power Station

SUITABILITY TO TASK

DOS
applications **EXCELLENT**

Windows
applications **EXCELLENT**

Expandability **GOOD**



THEY MAY HAVE HEARD THE BEST
DEAL ON EARTH JUST GOT BETTER.
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Presenting the remarkable color and monochrome LeaderBooks. Power, speed and reliability from a company that PC World says "gives you everything you want, including

combine a full featured 82-key keyboard with a built-in, 2-button Trackball. An easy to read 9-function LCD panel displays the system status including battery life,

performance, a perfect 10 in price and the best service and support in its group.

As a result of our commitment we back each product we make with some of the most comprehensive guarantees in the industry: A 30-day, no-questions-asked money-back guarantee, one year 100% parts and labor service coverage, an unlimited toll-free phone and FAX technical support line that "Computer Reseller News" ranked among the best.

Additionally we offer an on-line in-house tech support bulletin board and service forums available on both CompuServe® and Prodigy™.

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ANYTHING YET.

low price." Products like these have won us over a dozen patents and a reputation as a customer-driven service and support company.

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The 486/SLC LeaderBooks easily run 2½ times faster than most 386SX notebooks. And with the addition of a full color VGA LCD display at 640 x 480 resolution, the whole computing experience is enhanced. That means you're more productive, even away from the office.

If the 486/SLC Color LeaderBook doesn't excite you with its 256 colors or its incredible speed, then the price certainly will. Just \$2495. The Monochrome LeaderBook model is only \$1695. Both are loaded with features.

The LeaderBooks come standard with 4MB RAM and an 80MB hard drive. And in addition, they

ports for communications, external monitor and numeric keypad.

Of course both the color and monochrome versions come with MS-DOS® 5 and Windows™ 3.1 already installed so you can use them immediately, right out of the box.

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Quality is built in to all PC Brand computers. From the stringent evaluation of components to the bar coding of each part as a quality control procedure. In fact our "Get it right the first time" strategy prompted "PC Computing" to name two of our systems in the *Top 200 Products of 1992*. And also to award PC Brand a *Perfect 10* in



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LCD PANEL
DISPLAYS NINE
SYSTEM STATUS ICONS.



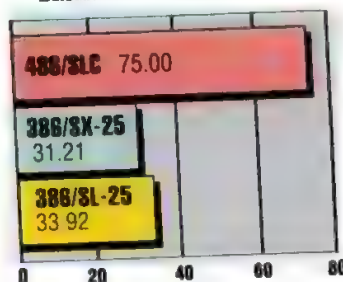
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- 486/SLC processor ■ 4 MB RAM ■ 80MB drive
- Internal 1.44 MB, 3.5" drive ■ Color VGA liquid crystal display (LCD), 256 colors, 640x480

LANDMARK V2.00 PERFORMANCE TEST



- resolution, 9" diagonal*
- External VGA monitor port
- Connector for docking station
- 1 parallel-1 serial port ■ Dual NiCad

- batteries and power adapter ■ Advanced power management features ■ Full-size keyboard, inverted "T" cursor layout, 12 Function keys ■ External keyboard port ■ Built-in 2-button trackball ■ MS-DOS® & MS Windows™ 3.1 pre-loaded
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- Carrying case ■ Available options: FAX/modem, auto adapter, spare NiCad

- battery, docking station
- 120MB drive available on both the color & monochrome
- LeaderBooks

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80 MB
4 MB RAM **\$1695**

486/SLC COLOR

80 MB
4 MB RAM **\$2495**

*Paper white VGA, 10" liquid crystal display, 640x480 resolution with 64 shades of gray on Monochrome LeaderBooks

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SPECIAL OFFER **\$999**

386/SX-33
 ■ 386SX/33 processor ■ 2MB RAM ■
 105MB drive ■ 1.44 MB floppy drive ■ 16-bit
 SVGA ■ Color SVGA monitor(1024 x 768,
 .39) ■ 1 parallel/2 serial ports ■ 200W
 power supply ■ 101-key keyboard ■ MS DOS ■
 Windows and mouse

\$1295

486/SXC-33
 ■ 486SXC-33 processor ■ 4MB RAM ■
 105MB drive ■ 1.2MB & 1.44 MB drives ■
 16-bit SVGA ■ Color SVGA monitor(1024 x
 768, .28) ■ 1 parallel/2 serial ports ■ 200W
 power supply ■ 101-key keyboard ■ MS DOS ■
 Windows and mouse

\$1395

486/SX-25
 ■ 486SX-25 processor ■ 64K cache ■ 4MB
 RAM ■ 105MB drive ■ 1.2MB & 1.44 MB
 drives ■ 16-bit SVGA with 1MB ■ Color
 SVGA monitor(1024 x 768, .28) ■ 1 parallel/2
 serial ports ■ Upgradable processor ■ 200W
 power supply ■ 101-key keyboard ■ MS DOS ■
 Windows and mouse

\$1595

486/DLC-40
NEW 170MB HD
 ■ 486DLC-40 processor with math coprocessor
 ■ 64K cache ■ 4MB RAM ■ 170MB drive ■
 1.2MB & 1.44 MB drives ■ 16-bit SVGA with
 1MB ■ Color SVGA monitor(1024 x 768, .28)
 ■ 1 parallel/2 serial ports ■ Upgradable
 processor ■ 200W power supply ■ 101-key
 keyboard ■ MS DOS ■ Windows & mouse

\$1795

486/DX-33
NEW 170MB HD
 ■ 486DX/33 processor ■ 64K cache ■ 4MB
 RAM ■ 170MB drive ■ 1.2MB & 1.44 MB
 drives ■ 16-bit SVGA with 1MB ■ Color
 SVGA monitor(1024 x 768, .28) ■ 1 parallel/2
 serial ports ■ Upgradable processor ■ 200W
 power supply ■ 101-key keyboard ■ MS DOS ■
 Windows and mouse

\$1995

486/DX2-50
NEW 170MB HD
 ■ 486DX2-50 processor ■ 64K cache ■
 4MB RAM ■ 170MB drive ■ 1.2MB & 1.44
 MB drives ■ 16-bit SVGA with 1MB ■ Color
 SVGA monitor(1024 x 768, .28) ■ 1 parallel/2
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CIRCLE 029 ON READER SERVICE CARD

equipment is sometimes sold in systems that can cost at least a thousand dollars more.

These components also managed to produce fantastic scores on our tests. The unit produced the best memory score of the machines in this review, and it also provided a top-five processor result. The Conner 213MB IDE hard disk, together with a 64K cache and Promise Technology ISA card disk controller with 1MB cache, combined to produce equally sterling DOS disk and Disk Winmark scores.

The Amax's Graphics Winmark score was also well above the average, but its DOS video score, this computer's only weak spot, fell below the average.

Amax Engineering Corp.'s one-year parts-and-labor warranty and optional \$69 on-site service isn't a great deal, but for a screamer like this PC at such a low price, you've got to sacrifice a little.—OR



FACT FILE

Amax 486DX2/50 ISA Power Station

Amax Engineering Corp., 47315 Mission Falls Ct., Fremont, CA 94539; 800-800-6328, 510-651-8886; fax, 510-651-3720

List price (tested configuration): \$1,995

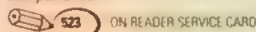
Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Conner CP30204 12-ms 210MB IDE hard disk with 256K cache, Promise Technology DC-99M ISA card disk controller with 1MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: ATI Graphics Ultra ISA card video controller with 1MB VRAM, MAG MX15H 14-inch monitor with a 76-Hz refresh rate at noninterlaced 1,024-by-768

Software: DOS 5.0, Microsoft Windows 3.1

In short: This incredible competitor has powerhouse performance, lots of expansion room, and excellent components.



American Mitac Corp.

American Mitac D4033

Like the system produced by its Agatech Computer Systems subsidiary, the \$1,995 American Mitac D4033 is a low-cost contender with modest upgrade capabilities.

The American Mitac comes in a small-footprint desktop case, which is preferable over the cramped slimline case favored by many bigger-name companies. This layout should provide enough room to add other boards in the future.

Under the hood, though, the Mitac's components are basically run of the mill. You'll find a 256K secondary SRAM cache (expandable to 512K) and a maximum on-board RAM capacity of 32MB, but the I/O ports, video, and drive controller circuitry are not integrated, and the video adapter's maximum noninterlaced resolution is only Super VGA. Furthermore, the board holds only 512K worth of video memory.

The rest of the system board has a problem common to low-cost systems: a chaotic design. Even with the extra internal space provided by the desktop case, the cable arrangement is messy and the SIMM banks are a little difficult to reach.

American Mitac wired extra I/O ports from the card out the back of a neighboring expansion slot, which means extra work should you want to expand there.

The computer's 14-inch monitor isn't anything special, either, though the picture is passable and it supports noninterlaced resolutions of up to 1,024-by-768 at a 72-Hz refresh rate.

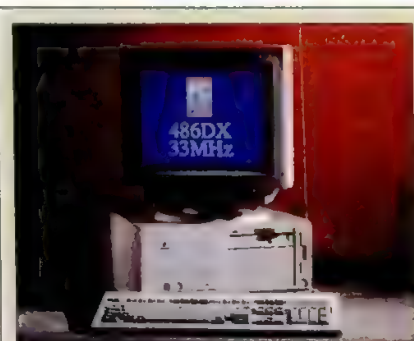
The American Mitac delivered typically average scores across the board on PC Magazine Labs' benchmark tests, with low video scores under both DOS and Microsoft Windows, but this is not shocking from such an outdated graphics adapter.

The company's warranty policy is also a little behind the times: one year on parts and labor, with a \$99 fee for on-site service.

American Mitac D4033

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR



FACT FILE

American Mitac D4033

American Mitac Corp., 48571 Milmont Dr., Fremont, CA 94538; 800-777-1688, 510-623-5300; fax, 510-623-5390

List price (tested configuration): \$1,995

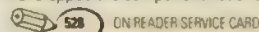
Memory and processor RAM cache: 4MB 80-ns SIMMs, 256K external cache.

Disk drives and controller: Conner CP30204 12-ms 213MB IDE hard disk with 64K cache, VITECH Super I/O ISA card disk controller, 1.2MB and 1.44MB floppy disk drives

Display: American Mitac AVGA2 ISA card video controller with 512K DRAM, American Mitac M1558 14-inch monitor with a 72-Hz refresh rate at Super VGA noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: This PC's older equipment includes an especially poor video card. American Mitac Corp. should have upped the component list or dropped the price



Other systems in this test group were able to provide superior performance for the same price or for less money. American Mitac either has to upgrade its low-cost entry or drop the price.—OR

American Super Computer

ASC 486/i33

The ASC 486/i33 was an average performer that lacks outstanding features. With its 33-MHz 486DX CPU and 64K cache, this \$1,988 system has no particular advantage over the other computers included in this review, and in terms of performance, it placed

ASC 486/i33

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

consistently in the middle of the range on PC Magazine Labs' benchmark tests.

This mini-tower PC from American Super Computer features five drive bays and eight ISA slots. The case is sturdy but has a few rough edges on internal structural pieces, which could be a problem when you want to upgrade internal components.

The ASC's 212MB Conner hard disk and Diamond video card with 1MB of video memory performed well, though they are garden-variety components; the Microscan 14-inch monitor, which can handle noninterlaced resolutions up to Super VGA, features precise controls, and its images were bright and had good color.

The computer's performance on our tests included faster-than-average memory and Disk Winmark scores. The lower-than-average Graphics Windows

number was due to the nonaccelerated Tseng video chip set. None of this computer's scores strayed far from the average, however. The unit PC Labs received for testing came with a 64K external RAM cache, but you can expand this to 1MB.

Sold by VARs and directly by a corporate sales force, the ASC doesn't come with a run-of-the-mill service and support package. The warranty covers parts and labor for two years. On-site service is available in two flavors: 24-hour or 4-hour response times; a two-year contract costs 7.5 percent of the system's list price for the former, and 15 percent for the latter.—BB

Ares Microdevelopment Inc.

Ares 486-25SX VL-Bus

The Ares 486-25SX VL-Bus is a good buy. At \$1,995, the system's internal components give you enough value to make up for the slower-than-average 25-MHz 486SX processor.

The components Ares Microdevelopment selected for this PC are all good choices. Included with the system are a Micronics motherboard, a Western Digital 210MB hard disk with a 64K cache, a Diamond SpeedSTAR accelerated video card, and a 14-inch ViewSonic monitor that supports noninterlaced resolutions of up to Super VGA at a 60-Hz vertical refresh rate.

The 486SX/25 CPU and lack of external RAM cache may have held back the Ares' performance, but its relatively low memory and processor scores on PC Magazine Lab's benchmark tests were balanced by a faster-than-average Graphics Winmark score, thanks to the video card's Western Digital WD90C31 Windows accelerator chip set. Expect this computer to perform even better in early 1993, when Ares says it will start selling an updated system with a local-bus version of the Diamond SpeedSTAR video controller.

The Western Digital hard disk, combined with the motherboard-integrated but cacheless disk controller, managed only a bottom-level DOS disk score. Yet it produced one of the strong-



FACT FILE

Ares 486-25SX VL-Bus

Ares Microdevelopment Inc., 23660-A Research Dr., Farmington Hills, MI 48335; 800-322-3200, 313-473-0808; fax, 313-473-4450

List price (tested configuration): \$1,995

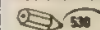
Memory and processor RAM cache: 4MB 70-ns SIMMs.

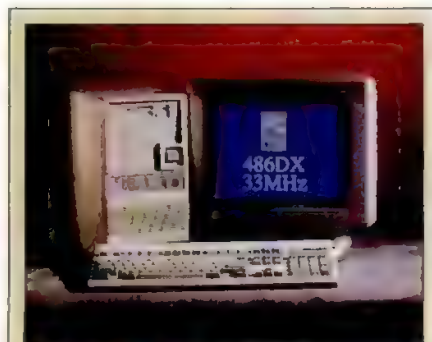
Disk drives and controller: Western Digital Caviar 2200 14-ms 210MB IDE hard disk with 64K cache, integrated disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Diamond SpeedSTAR 24X ISA card video controller with 1MB DRAM, ViewSonic 4E 14-inch monitor with a 60-Hz refresh rate at noninterlaced 800-by-600

Software: DOS 5.0, Microsoft Windows 3.1

In short: This \$1,995 PC is a good deal, despite its slow processor and fluctuating performance scores. It has excellent parts and lots of expansion room.

 530 ON READER SERVICE CARD



FACT FILE

ASC 486/i33

American Super Computer, 1306 Orleans Dr., Sunnyvale, CA 94089; 800-457-2243, 408-752-8150; fax, 408-752-8160

List price (tested configuration): \$1,988

Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K external cache

Disk drives and controller: Conner CP30204 12-ms 212MB IDE hard disk with 64K cache, Kowell KW-556F ISA card disk controller, 1.44MB floppy disk drive.

Display: Diamond SpeedSTAR ISA card video controller with 1MB DRAM, Microscan 2E 14-inch monitor with 59-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The \$1,988 ASC 486/i33, from American Super Computer, is an average machine with no compelling attractions, with the exception of its powerful 33-MHz processor

 529 ON READER SERVICE CARD

est Disk Winmark scores of this roundup.

The Ares comes in a full-size desktop case with six drive bays and eight expansion slots, two of which are the desirable VESA-VL bus slots.

Ares, which sells systems via mail-order only, includes a warranty that covers parts for two years and labor for the life of the PC. In addition to a 24-hour toll-free technical-support number, the company also provides on-line support through Prodigy.

If the processor's performance—which placed it near the bottom of the pack—bothers you, it may be wise to buy a system with a faster

CPU. As it stands, however, the Ares is a very good deal given its quality components, solid performance, adequate support, and low price.—BB

Ares 486-25SX VL-Bus

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

Ariel Design Inc.

Ariel 486SX/25 Best Value

The strengths of the \$1,999 Ariel 486SX/25 Best Value are its expandable mini-tower case and serviceable components. However, the product's scores on our benchmark tests tag Ariel Design's computer as an also-ran.

The 486SX/25 Best Value's case is configured with six drive bays, providing a good deal of expansion room. The motherboard also accepts up to 64MB of RAM on board. Unlike many other vendors, Ariel Design isn't using an

Ariel 486SX/25 Best Value

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR



FACT FILE

Ariel 486SX/25 Best Value

Ariel Design Inc., 145 Webster St., Hanover, MA 02339; 800-952-7435, 617-982-8800; fax, 617-982-9095

List price (tested configuration): \$1,999.

Memory and processor RAM cache: 4MB 80-ns SIMMs

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, Ariel MIO-500 ISA card controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond SpeedSTAR 24X ISA card video controller with 1MB DRAM, ViewSonic 4E 14-inch monitor with a 72-Hz refresh rate at noninterlaced 800 by 600

Software: DOS 5.0, Microsoft Windows 3.1, plus choice of Quattro Pro for Windows 1.0, Paradox 4.0, or Borland C++ for Windows/DOS 3.1.

In short: Solid components and expansion options may persuade you to overlook this PC's weak performance.

471 ON READER SERVICE CARD

old motherboard design to keep costs low. To be sure, you won't find EISA architecture or local-bus connectors on the 486SX/25 Best Value, but there is an upgrade socket for an alternative processor (in case you want to step up to DX2/50 power) and the external cache is on a removable card, making for an easy upgrade there, too.

The design of the 486SX/25 Best Value gives users as much upgrade potential as they can expect for the product's price. And you may want to upgrade fairly quickly, as the PC's benchmark results were hardly complimentary. Suffering from bottom-scraping scores on the processor and disk tests, the 486SX/25 Best Value was further blemished by below-average results on the memory and Disk Winmark tests. The system's DOS video score was average, though.

An ISA Diamond SpeedSTAR 24X card handles video and is wired to a solid Viewsonic 4E monitor, which explains the strong showing in the Graphics Winmark test. Though this display is not on the cutting edge, it has a pleasant picture and conveniently located analog controls that are sufficient for most users.

Ariel Design has a one year warranty for parts and labor and a \$50 fee for on-site service. The 486SX/25 Best Value's expandability is a big plus, but it may not be enough to compensate for the product's modest test results.—OR

Austin Computer Systems Inc.

Austin 486/DX2-50 WinStation

The Austin system is one of the best buys for under \$2,000. The \$1,990 Austin 486/DX2-50 WinStation produced generally excellent benchmark scores, thanks largely to its better-than-average processor, backed by 70-ns RAM and a 128K external RAM cache. Parts, service, speed, and price are all here.

The WinStation comes in the same baby AT-style, small-footprint desktop case that Austin Computer uses for many of its other systems. This case has five drive bays and lets you fill all of the system's eight expansion slots.

Austin 486/DX2-50 WinStation

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD

VENDOR SERVICE & RELIABILITY

Reliability	AVERAGE
Repair Service	AVERAGE
Tech Support	AVERAGE

The test unit had a single proprietary slot, but units that begin shipping in February will have a VESA VL-bus—at an added cost. The motherboard is two-thirds the size of the typical AT motherboard. The case is sturdy and nicely finished, though it has a few rough edges. Unlike many other cases we reviewed, this one is metal, not plastic.

The performance-oriented component list includes an Austin mouse, Western Digital Caviar 2200 200MB hard disk, and an STB PowerGraph-X24 video card with an S3 video chip and 1MB of video RAM. The card has a resolution of 1,024 by 768. The monitor is from Austin and features 24-bit color. Although it lacks horizontal size control and the re-



FACT FILE

Austin 486/DX2-50 WinStation

Austin Computer Systems, 10300 Metric Blvd., Austin, TX 78758; 800-752-1577

List price (tested configuration): \$1,990

Memory and processor RAM cache: 4MB 70-ns SIMMs, 128K external cache.

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, Austin Computer Systems ISA-card disk controller, 1 2MB and 1 44MB floppy disk drives

Display: STB Systems PowerGraph-X24 ISA-card video controller with 1MB DRAM, CTX CVP-5468NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 non-interlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, ViruScan, Version 97

In short: This PC is an excellent choice with great parts, fast performance, and reliable support.

472 ON READER SERVICE CARD

COVER STORY
Low-Cost PCs

fresh rate is a nominal 60 Hz, it generates a good, crisp image.

The payoff from the combination of Austin's motherboard, CPU, RAM, hard drive, and video controller is fast performance on most tests. The video score was a little slow and the DOS disk test numbers were just a little above average, but by every other measure this system was quite fast—particularly the third-place processor score and fifth-ranked Graphics Winmark result.

In service and support, Austin Computer Systems provides one-year on-site service from GE Onsite and 24-hour 800-number technical support. Whether you're spending your company's money or your own, the Austin computer is a great choice.—BB

Broadax Systems Inc.

BSI 486DX2-50

Not every machine can be a winner. The \$1,888 BSI 486DX2-50's rough case, slow overall performance, and lack of on-site service even as an option (rare for a mail-order vendor such as Broadax Systems Inc.) make this a less-than-optimum package.

The BSI 486DX2-50 comes in a very large, sturdy case, but there are many rough edges on internal support pieces. The case has room for seven drives—this is great if you need it, but in today's market, a system with that much storage generally would contain a faster processor.

The BSI 486DX2-50's 50-MHz 486DX2 CPU has a 256K external RAM cache and 70 ns of RAM. The processor benchmark test score was among the highest of the systems reviewed, but the machine's other scores were average or below. The Disk Winmark score was low, and the Graphics Winmark and DOS memory ratings were virtually at the bottom of the pack.

The monitor is a satisfactory 14-inch CTX with 1,024-by-768 resolution and a refresh rate of 60 Hz; it combines with an OPTi video card to generate crisp colors. The BSI motherboard con-



FACT FILE

BSI 486DX2-50

*Broadax Systems, Inc., 9440 Telstar Ave.
Suite #4 El Monte, CA 91731; 800-872-4547,
818-442-0020; fax, 818-472-4527*

List price (tested configuration): \$1,888

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, BSI PM560DG ISA card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Paradise SVGA ISA-card video controller with 1MB DRAM, CTX 5468NI 14-inch monitor with a 60-Hz refresh rate, and 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0 and Microsoft Windows 3.1.

In short: BroadaxSystem's \$1,888 486DX2-50 loses points because of its slow performance and the lack of on-site service.

 ON-READER SERVICE CARD

tains eight 16-bit slots and there's enough room around them for full-length cards. Because the motherboard doesn't flex, the cards seat properly.

Although the case's capacity for drive expansion makes up for its rough edges, and the computer's performance might increase with further system-tweaking, buying a system by mail order without on-site support isn't wise. Weekday technical phone support is available, but if the unit needs repairs that you can't perform yourself with the help of telephone support, you will have to send the system to the company's California facility.

The warranty is standard: one year parts and labor, but there's no on-site service. If you're seeking the kind of expansion room the BSI provides, other vendors with faster-performing but smaller computers usually can provide a tower-case upgrade for \$75 to \$100.—BB

C² Micro Systems Inc.

C² Saber 486/SLC

The C² Saber 486/SLC's low test scores on PC Labs' benchmark tests reduce the appeal of the better-than-average components and fine case of this \$2,075 computer from C² Micro Systems.

The root cause of the C² Saber's low benchmark scores is its 25MHz Cyrix 486/SLC CPU, with no external RAM cache. The C² Saber had one of the lowest processor test scores among the more than 60 systems in this review; and the

computer is without a cache upgrade option. The system also turned in low scores on the memory and Disk Winmark test.

The ALPS 210MB IDE hard disk, with 32K cache, is a name-brand device and the Ultrastor IDE ISA caching-disk controller, with a 2MB hard disk cache, is a well-made unit. Neither item helped the system excel in the benchmark tests, however.

The MegaImage 14-inch monitor is capable of running at a 72-Hz vertical refresh rate with 1,024-by-768 noninterlaced resolution. The monitor is supported by a video card containing the Western Digital chip set.

The DOS disk and the video and Graphics Winmark scores were all mid-range among the systems tested, however. This detracts from the appeal of the otherwise-capable monitor.

The C² Sabre has a small-footprint, desktop-style case with a nice finish and design. It has room for six drives with two 1-inch-thick, 3.5-inch form-factors. There are three external 5.25-inch drive bays and one external 3.5-inch drive bay.

The cards seat properly in the seven 16-bit ISA expansion slots because the motherboard doesn't flex. Memory is easily accessible. For external devices, the motherboard features two serial ports and one parallel port.

The company offers a one-year parts-and-labor warranty with free on-site service for the first year. Although the case is handsome, and the components are ca-

C ² Saber 486/SLC	
SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	GOOD

BSI 486DX2-50

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

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Publisher:
WordPerfect Corporation
WP197/\$5

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386MAX 6

Winner of 1991 PC Magazine Editors' Choice, the Byte Award of Merit, InfoWorld's Buyers Assurance Seal, and InfoWorld's Top Scoring Memory Manager. 386MAX 6 is perfect for both the experienced user and the novice. A new graphical interface seamlessly integrates memory management with SmartMemory, a disk cache and powerful system analyzer. After reliably recovering maximum high DOS memory, 386MAX automatically optimizes and configures your system for the most conventional memory. Publisher: Qualitas

Also available: **BlueMAX 6** 1T167/\$79.

\$61

Typecase II

Typecase II is a versatile library of over 100 TrueType fonts that install seamlessly into Windows 3.1. Typecase TrueType fonts are scalable from 1 to 999 points and are compatible with every Windows-supported printer and monitor. This collection of state-of-the-art text, decorative and international symbol fonts is great as an addition to the original Typecase or as a stand alone font library.

Also available: **Typecase GR513/\$5 \$39**. Publisher: SWFTE
Typecase II GR585/\$5

\$37

WinFax PRO 3.0

WinFax PRO 3.0 makes it easy to send, receive, and manage faxes from within Windows. Since WinFax PRO installs just like a Windows printer, you can send faxes just as easily as you print documents—directly from Windows applications. Sophisticated document management tools let you categorize faxes using detailed descriptions, keywords, and archiving capabilities. Mark up faxes with powerful annotation tools. State-of-the-art OCR technology converts incoming faxes into editable files for your word processor or spreadsheet. WinFax PRO now includes Cover Your Fax, 100 useful and attractive fax cover sheets. Or use the new Cover Page Designer and create your own. Maintain Multiple phone books and create groups for easy broadcast faxing. Supports most popular Class 1, Class 2, CAS and SendFax modems. Publisher: Deirina Technology FX0334

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BS7183/5	★ Paradox 4.0	539
SO533/5	★ Quattro Pro for Win. Competitive Upgrade 95	95
BS7313/5	★ Quattro Pro 4.0 for Windows	309
LN0463/5	★ Turbo C++ for Windows	105
Broderbund	BS1834 PC Globe 5.0	43
EN0734	SimCity	29
ED0184	Where in the USA is Carmen San Diego	32
Brown Wagh	EX1800 Sound Blaster Pro	189 95
Caero	IN2520 OmniPage Direct	269
FX0314	★ FaxMaster	99

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Publisher:
Palo Alto
BS7384

\$75

Calera	UT2304 ★ FAXGrabber	105
Canon	PR1500/10 Bubble Jet BJ-10ex (White/Gray)	299
Central Point Software	UT3033/5 ★ PC Tools Deluxe 8.0	129

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Niles & Associates
BS6284
\$139

Chipsoft	TX0554 TurboTax 1040 1992 Final	49
Claris	BS7234 ★ FileMaker Pro 2.0 for Windows	269
Computer Associates	GR1823 CA Cricket Graph 1.3	85
Contact Software	BS6954 ★ ACT! for Windows	249
Corel Systems	GR5443/5 ★ CorelDRAW! 3.0	389 95
Darlene Tech.	UT2843 ★ WinSleuth Gold 3.0	105
Datamation Corp.	CM0634 ★ PROCOMM PLUS for Windows	95 95
DCA, Inc.	CM0654 ★ Crosstalk 2.0 for Windows	119
Delrina Technology	FX0154 ★ WinFax Pro 3.0	75
Digital Vision	EX1610 ComputerEyes Color/RT	469
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Fifth Generation	UT0724 Direct Access 5.1	65
Fractal Design Corp.	UT1884 FastBack Plus 3.1	125
Generic Software	GR5344 ★ Painter	259
GFA Technology	CA0074 Generic CADD 6.0	285
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Iomega	CM0294 Smartcom Exec 2.1	75
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Jetset Systems	UT1614 HiJaak 2.1	119
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	LN0543/5 ★ C++ Compiler	219
	JP0153/5 DOS 5.0 Upgrade	65 95
	BS3253/5 ★ Excel 4.0 for Windows	299 95
BS7574	★ FoxPro 2.5	515
IN0890/80	Mouse (bus/ser)	85 95
IN275/84	★ Mouse w/Windows (bus/ser)	145 95
BS7253/5	★ Office 3.0 for Windows	485 95
BS2704	★ Project 3.0 for Windows	445 95
LN0603/5	Visual Basic 2.0 for Windows	99
WP0373/5	★ Word 2.0 for Windows	299 95
BS5324	★ Works for Windows	129 95
MicroSolutions	DR1240 Backup 1.4	210
	DR1790 Backup 2.8	249
MicroTouch Systems	IN0810 The JnMouse	165
MicroWarehouse	BN0960 386/SX 33 MHz w/Color Monitor	999
BN0970	486/SX 25 MHz w/Color Monitor	1349

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Publisher:
Avantec
BS7514

\$239

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	MT0280 PanaSync C1381 14" VGA Color	369
New Vision Technology	GR3174 ★ Presentation Task Force CGM 4.0	134 95
Horizon-Lambert	CM0503/5 ★ Close-Up Dual Pack 1/Win & DOS	119
Panasonic	PR2200 KX-P1124i Printer	299 95
	PR2190 KX-P2624 Silent	419
Peachtree Software	FN0654 Peachtree Basic Accounting 6.0	75

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Software Marketing
ED5071

\$39

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Quark	BN1153 QuarkXPress for Windows	595 95
Quarterdeck Office Systems	EX1103/5 QEMM 386 6.0	
Reference Software	WP0334 Grammatik 5 for DOS	
Software Marketing	WP0514 ★ Grammatik 5 for Windows	
Software Publishing	ED3734 Autoworks	49
Softkey Software	GR5494 Key CAD Complete	
Software Publishing	GR2303/5 ★ Harvard Graphics 3.0	119 95
Stac Electronics	GR5063/5 ★ Harvard Graphics for Windows	
Stacker 3.0	UT3094 ★ Stacker 3.0	
Symantec	UT2183/5 ★ Norton Desktop for Windows	
	UT2453/5 Norton Desktop for DOS	
Targus	AC0670 Universal Notebook Case	69 95
Tec	DR0910 Tec 3.5 1.44 FD	119
Teleware	FN0413 ★ M Y O B for Windows	139 95
The Complete PC	IN2110 Dom. Page Scan w/ WordScan OCR Soft	
	EX0060 The Complete Communicator 3.0	
T/Maker	GR5104 ★ FastMenu	219 95
Touchstone	UT0734 CheckR PLUS	69 95
Traveling Software	UT2074 ★ aptLink Pro 4.0	99 95
WordPerfect Corp.	WP0363/5 ★ WordPerfect 5.1	269 95
	WP1313/5 ★ WordPerfect 5.2 for Windows	
Xtree Company	UT2783/5 ★ Xtree for Windows	
Zoom Telephonics	MM2120 AFX Ext. 9600/4800 S/R Fax	
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\$134.95

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FACT FILE

C² Saber 486/SLC

C² Micro Systems Inc., 47560 Seabridge Dr., Fremont, CA 94538; 510-683-8888; fax, 510-683-8662

List price (tested configuration): \$2,075

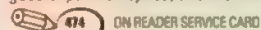
Memory and processor RAM cache: 4MB 70-ns SIMMs

Disk drives and controller: ALPS 312C901A 13-ms 210MB IDE hard disk with 32K cache, Ultrastor 15C ISA-card disk controller with 2MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond SpeedSTAR-24X ISA-card video controller with 1MB DRAM, Megalimage CAC14NF 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: Microsoft Windows 3.1, DOS 5.0

In short: The \$2,075 C² Saber 486/SLC's overall performance is too slow to make up for its handsome case, good expansion space, and well-made components.



pable, the C² Saber 486/SLC can't qualify as a bargain because of the system's lackluster performance on our benchmark tests.—BB

Clover Computer Systems Inc.

Clover 486-SXC

When you turn on the Clover 486-SXC or remove its desktop casing and look inside, fireworks won't go off in your imagination. But when you remember the

price you paid, you'll probably grin a little bit. Clover Computer Systems has included a package of respectable though unspectacular components

in its 486SX/25 unit, plus a few goodies such as a 9,600/2,400-bps send/receive fax modem that includes WinFax PRO software. The components and extras help make the Clover an appealing system at one of the lowest prices (\$1,395) among the computers we reviewed.

Everything on the Clover's spacious motherboard is accessible, including the SIMM banks, which hold 32MB of RAM, and a coprocessor socket. The disk and video controllers are on ISA cards, leaving three 16-bit and two 8-bit slots free.

The performance of the Clover 486-SXC was similar to that of other 486SX/25 systems in our roundup. Its 213MB Maxtor hard disk with 64K buffer proved to be its strongest feature, but it came out a tad below average on the DOS disk test and Disk Winmark in comparison to the entire test group. The Acumos video card held its own on the DOS video and



FACT FILE

Clover 486-SXC

Clover Computer Systems Inc., 1430 Koll Circle, #102 San Jose, CA 95112; 800-925-6837, 408-436-0444; fax, 408-436-0494

List price (tested configuration): \$1,395

Memory and processor RAM cache: 4MB 70-ns SIMMs

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, Clover Computer Systems DLU 270 ISA-card disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Acumos video controller with 512K of RAM; Impression Ultra VGA 14-inch monitor with a 60-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, Prodigy Starter Kit, Spinnaker Eight-In-One, McAfee Antivirus, WinFax PRO, 9,600-/2,400-bps fax modem.

In short: This PC's price tag may be especially appealing to those who value such extras as a fax modem.



Graphics Winmark tests, but it is capable of only 800 by 600 pixels at its highest noninterlaced resolution. The Impression Ultra VGA monitor leaves a little to be desired with a top resolution of 800 by 600. Unfortunately, Clover Computer Systems does not offer many options (an ADI 3E+ monitor is available for \$105) so what you see with the 486-SXC is probably what you'll have to settle for.

To its credit, Clover offers toll-free technical support Monday through Saturday and on-site service for \$50 a year. Clover also throws in the Prodigy Starter Kit, a McAfee anti-virus bundle from McAfee Associates, and Spinnaker Software Corp.'s Eight-in-One for Windows integrated package. At its price, this Clover is worth a look.—Brad Grimes

Comex Computer Corp.

Comex 486SX/25 VESA

It's gone largely unnoticed in the noisy world of PCs, but Tucson, Arizona-based Comex Computer Corp. has quietly been producing high-quality systems. Its \$1,995 486SX/25 VESA machine is no exception. This desktop unit contains quality features and has room for future expansion, at a reasonable price.

The spacious Micronics motherboard hosts two VESA local-bus slots, one of which is occupied by a video card while the other stands in wait for a possible disk controller.

The Micronics processor RAM cache is placed in a SIMM socket for easy upgrading, and there's an Intel upgrade socket for an OverDrive chip. The system includes Flash BIOS for downloading updated code without replacing the ROM BIOS chip. Overall, the motherboard is clean and accessible with eight 16-bit slots and five drive bays awaiting expansion. You also get a Dexxa mouse.

You might want to consider another video card if you'll be using Windows a lot. The card shipped with the system, with its Tseng chip set, can't keep up with competing cards in Windows graphics performance. Unfortunately, Comex

Comex 486SX/25 VESA

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Expandability	GOOD

Clover 486-SXC

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Expandability	FAIR

doesn't offer anything better.

The Western Digital Caviar 2200 hard disk with 32K buffer is a quality drive; but again, it doesn't perform as well as some others on our tests. A 1.2GB SCSI hard disk is available for \$1,250.

Amazing Technologies manufactures the monitor, which offers reasonable images at a noninterlaced 1,024-by-768 resolution. Comex offers a 20-inch MAG Innovision monitor capable of 1,280 by 1,024 pixels at its highest noninterlaced resolution for \$950.

The company also offers a two-year parts-and-labor warranty, with free overnight service during that time. Technical support is available toll-free, Monday through Friday.

This system is well-built and worth a serious look. Comex seems to be a quality small company you may want to get to know better.—BG



FACT FILE

Comex 486SX/25 VESA

Comex Computer Corp., 3450 South Broadmont #110, Tucson, AZ 85713; 800-926-6392, 602-792-0100; fax, 602-792-9722

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K external cache.

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, IDE-controller, 1.2MB and 1 44MB floppy disk drives

Display: Comex VESA Local Bus video controller with 1MB DRAM, Amazing Technologies CM-8428MX 13-inch monitor, 60-Hz refresh rate at 1,024 by 768.

Software: DOS 5.0, Microsoft Windows 3.1

In short: Little-known Comex Computer Corp. offers this well-built system at a reasonable price. While the VESA local bus and a Micronics motherboard are the highlights, several of the components didn't perform as well as the corresponding components in other PCs.



ON READER SERVICE CARD

Compaq Computer Corp.

Compaq Prolinea 4/33

With many of the market's larger manufacturers, low-end prices don't mean merely a little less power, but a smaller case with less expansion room as well. Compaq's \$2,232 Prolinea 4/33, part of the company's widely heralded low-end line, is no exception.

The Prolinea is based on an Intel 486DX/33 processor. The unit's slimline case contains features you need today, but has little room for upgrades. The system has only one empty drive bay and three vacant 16-bit expansion slots, so you must choose peripherals wisely. On the plus side, the motherboard is nicely equipped with VLSI components and is fully integrated. A Compaq mouse comes bundled.

A few of the components that Compaq included were below par. The video scheme relies on the Tseng ET4000 chip set, which performed poorly on the Windows portions of our benchmark tests. On the other end of the video subsystem is Compaq's 14-inch SVGA monitor, able to handle a maximum resolution of only 800 by 600 noninterlaced, and even that at a refresh rate of only 60 Hz—VESA (the Video Electronics Standards Association) recommends 70 Hz. The monitor does have front-mounted digital controls, however. And even though the 240MB Quantum hard disk is decent enough, the computer's lack of an external processor cache means a difficult upgrade to a DX2 66MHz processor.

The Prolinea climbed into the top ten with its memory and Disk Winmark scores. Processor speed was right in the middle and the DOSmark score was a tad above average.. The system ranked a little above average on the DOS video test, but the Tseng ET4000 caused the Graphics Winmark score to plummet.

A one-year parts-and-labor plus on-

Compaq Prolinea 4/33

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair Service	AVERAGE
Tech Support	AVERAGE



FACT FILE

ProLinea 4/33

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670; fax, 800-345-1518

List price (tested configuration): \$2,232

Memory and processor RAM cache: 4MB 70-ns SIMMs.

Disk drives and controller: Quantum LPS240 16-ms 240MB IDE hard disk with 256K cache, integrated disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Integrated video controller with 1MB DRAM, Compaq SVGA 14-inch monitor with a 60-Hz refresh rate at 800-by-600 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: Compaq Computer Corp. has delivered a computer that features decent performance but has components that are below par. Another shortcoming of the ProLinea 4/33 is that the system offers little room for growth.



ON READER SERVICE CARD

site service warranty rounds out this system. The price would fall below our \$2,000 ceiling with the standard 15 percent dealer's discount. If Compaq's reputation is a key factor for you, then the Prolinea will be worth investigating, but there are better values out there.—OR

Comp & Soft Experts

CS 486/33C256

If you run across this Comp & Soft system but have never heard of the company, it may be reassuring to note that their phone number is right on the nameplate. You may want to keep it handy if you intend to perform upgrades or other work inside this mid-tower case.

The system doesn't employ any cutting-edge designs: The disk controller is on an ISA card, as is the video controller.

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IBM LASERPRINTERS PAGES AHEAD

Unfortunately, the way these cards are configured inside the CS 486/33C256 results in a messy array of ribbon wires and connectors. You'll have a hard time getting to the CPU, the AMI BIOS, or the two open 8-bit ISA expansion slots. Upgrading the processor would certainly be a chore—if the unit had an upgrade path worth following. There is no upgrade socket. If you want to upgrade to a 486/50, for instance, as Comp & Soft Experts says you can, you'll need the proper tools as well as clock crystals. But don't count on getting two hands into this personal computer without extracting most of its insides.

The CS 486/33C256's performance is



FACT FILE

CS 486/33C256

Comp & Soft Experts, 12011 St. Charles Rock Rd., Bridgeton, MO 63044; 800-327-8486, 314-298-1900; fax, 314-298-9674

List price (tested configuration): \$1,995.

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, Comp & Soft Experts ISA-card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Palo Electronics SVGA ID ISA-card video controller with 1MB DRAM, ViewSonic 6E 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1

In short: Poor interior organization and no processor upgrade path overshadow this PC's decent components.



not as poor as its design might suggest. That is thanks, in part, to components such as the Maxtor hard disk and Western Digital Paradise video chip set. The 256K of processor RAM cache helped the machine to a respectable score on our DOS memory test, but nothing will make this system a Windows workhorse. Its Windows scores were not impressive.

The Missouri-based company offers a one-year warranty on parts and labor as well as a five-year free check-up policy. On-site service is an option at \$129 a year. You get a Z-nix Super Mouse II with the package.

Even if you don't mind dealing with little-known PC vendors, there are many others who offer a lot more in a low cost PC that you might want to consider.—BG

CompuAdd Computer Corp.

CompuAdd 425SLC Low Profile

CompuAdd Computer's version of the below-\$2,000 slimline, the 425SLC Low Profile, comes in at \$1,703 and is slightly roomier than similar products from companies such as Compaq or Dell. But with its not-quite-a-486 Cyrix processor, this system ends up being merely another low-cost contender with cramped upgrade space.

The system contains three drive bays; one of them is left empty. A dual 1.2MB and 1.44MB floppy disk drive is installed in one of the bays, which leaves a drive bay open. In addition to the usual three 16-bit slots, two 8-bit expansion slots are mounted on the back of the T-bar backplane.

These little pluses are nice, but the rest of CompuAdd's system is composed of the usual low-cost componentry, and the product's documentation is written primarily for the beginner. While the unit offers ample room for modest expansion, those with extensive expansion plans should still seek something with a little more internal room.

The CompuAdd 425SLC Low Profile's performance wasn't as eye-catching as its well-engineered internal layout. The CompuAdd's scores



FACT FILE

CompuAdd 425SLC Low Profile

CompuAdd Computer Corp., 12303 Technology Blvd., Austin, TX 78727; 800-627-1967, 512-250-1489; fax, 512-331-6236

List price (tested configuration): \$1,703.

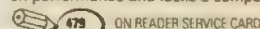
Memory and processor RAM cache: 4MB 60-ns SIMMs

Disk drives and controller: Western Digital Caviar 2200 14-ms 170MB IDE hard disk with 64K cache, integrated disk controller, dual 1.2MB and 1.44MB floppy disk drive

Display: Integrated video controller with 1MB VRAM, Samtron SC-428VS 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1, NetWare Lite 1.1, CompuServe Starter Kit.

In short: This PC packs a lot of punch but falls short on performance and lacks a competitive warranty.



were below average across the board.

The 486SLC/25 Cyrix processor ranked very near the bottom on our processor test, while the Western Digital hard disk was among the bottom 15. The video score was in the middle but the

Graphics WinMark score sank to the bottom—not surprising, because the Western Digital video chip set performs better under DOS than with Windows. For the most part, however, the 486SLC Low Profile's components were just a little behind the pack..

CompuAdd Computer's warranty policy includes two years of labor, one year on parts. There's a \$90 charge for on-site service; the on-site service is supplied by Memorex Telex.—OR.

CompuAdd 425SLC Low Profile

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	AVERAGE
Repair Service	ABOVE AVERAGE
Tech Support	ABOVE AVERAGE

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THE IBM COLOR JETPRINTER PS: COLOR MADE BRILLIANTLY CLEAR.

CompuAdd Express

CompuAdd Express 440DLC/Scalable

The \$1,894 CompuAdd Express 440DLC/Scalable, like its CompuAdd 425SLC Low Profile corporate sibling (also reviewed), doesn't excel in terms of expansion or performance, but it still offers a few more features than the typical low-cost, pizza-box-shaped PC.

Based on a Cyrix Cx486DLC/40 processor, this slimline shares some features

CompuAdd Express 440DLC

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **FAIR**

with the CompuAdd 425SLC, which uses a Cyrix Cx486SLC/25.

Like its sibling, the 440DLC offers five vertically mounted expansion slots: three

16-bit and two 8-bit. The latter two are mounted on the rear of the backplane, but they may be difficult to use because of the placement of some cables.

Unlike the other CompuAdd system, the 440DLC fills one 16-bit slot with a Practical Peripherals 2400FX96 9,600/2,400-bps fax modem. Most other components are name brands (though the Conner 170MB hard disk was a bit small), except for CompuAdd's monitor, which showed washed-out colors when running Windows.

The unit includes a Cyrix 80387 math coprocessor in hopes of increasing performance to Intel 486 levels. Though it's no slug, the processor still turned in below-average processor and memory scores (running against Intel 486DX/33s and 486DX2/50s).

The motherboard offers a standard 486 socket in case you need to upgrade. A motherboard-integrated IDE drive controller imitated the one in the CompuAdd 425SLC Low Profile with disk performance scores among the bottom ten entries under DOS and Windows. The system used Tseng's ET4000 chip set on its proprietary local-bus video subsystem, which garnered it the top score in the DOS video test, but yielded below-average Windows performance.



FACT FILE

440DLC Scalable

CompuAdd Express, 12301 Technology Blvd., Austin, TX 78727; 800-925-3000, 512-219-1800; fax, 512-219-2890

List price (tested configuration): \$1,894

Memory and processor RAM cache: 4MB 70-ns SIMMs, 128K external cache.

Disk drives and controller: Conner CP30174E 17-ms 170MB IDE hard disk with 32K cache, integrated disk controller, dual 1.2MB/1.44MB floppy disk drive.

Display: Integrated video controller with 1MB DRAM, CompuAdd 51109 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: A slightly more competitive price than most and an included fax modem make this entry attractive. It ranked first on the DOS video test and had an above-average memory score, the other benchmark test scores, however, dropped below average.

ON READER SERVICE CARD

CompuAdd Express offers a one-year parts-and-labor warranty with free on-site service for the first year.—OR

Comtrade

486 VESA Local Bus WinStation

The local bus video on Comtrade's \$1,945 486 VESA Local Bus WinStation adds first-rate graphics and video capability to a machine that also has a competent motherboard and plenty of expansion room.

Once you look past graphics, though, the rest of the system produced only average benchmark test scores. The mid-size tower case is a bonus, providing plenty of room for drive-bay expansion. The motherboard is less than attractive: Wire traces and cables are draped in a rag-tag fashion over the middle of the system's

interior. An I/O card takes up one expansion slot and blocks another by wiring the extra ports through a neighboring slot cover, something which could have been avoided by routing them through one of many available cutouts in the case.

STB's PowerGraph VL-24 card sits in a VESA-compliant local-bus socket and is based on an S3-805 chip. Graphics are displayed on a clean CTX CMS-1461 Multiscan monitor. This is not in the league of anything from NEC, but it's certainly a serviceable monitor with a good picture. There is an alternative processor socket as well as 256K of external cache in case you've got aspirations to upgrade

Comtrade 486 WinStation

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **FAIR**



FACT FILE

Comtrade 486 VESA Local Bus WinStation

Comtrade, 15314 East Valley Blvd., City of Industry, CA 91746; 800-969-2133, 818-961-6688; fax, 818-369-1479

List price (tested configuration): \$1,945

Memory and processor RAM cache: 4MB 60-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital Piranha 4200 13-ms 213MB IDE hard disk with 64K cache, Comtrade AB757 ISA-card disk controller, 1.2MB and 1 44MB floppy disk drives.

Display: STB PowerGraph VL-24 VESA local-bus-card video controller with 1MB DRAM, CTX CMS-1461 Multiscan 13-inch monitor, 72-Hz at 1,024 by 768

Software: DOS 5.0, Microsoft Windows 3.1.

In short: This PC has an expandable mid-size tower case, VESA-compliant local-bus video, and competitive test scores.

ON READER SERVICE CARD

“If Lexmark is an indicator of the kind of innovation we can expect from an IBM spin-off, OS/2 users have much to look forward to...”

*OS/2 Professional Magazine,
November 1992*

“The LaserPrinter 10 is appropriately named. It is close to a perfect 10...”

*Computer Reseller News,
February 3, 1992*

“Lexmark offers the best combination of price and performance for printers used for desktop publishing.”

*Windows Magazine,
February 1992*

“With the IBM LaserPrinter 6, Lexmark proudly comes into its own on the laser printer turf by paying special attention to paper handling and resolution quality. This workhorse prints on both delicate stationery and card stocks, and can deliver a jaw-dropping 600-by-600 dpi resolution.”

*ComputerLand Magazine,
April 1992*

“The 4079 is a watershed color printer. The list of features, low pricing, solid warranty... all combine to make this a color inkjet printer against which others will be measured.”

*BIS Strategic Decisions,
October 1992*

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*BYTE Magazine,
July 1992*

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CIRCLE 081 ON READER SERVICE CARD

to a DX2/50. Keep in mind that much of this is equipment that larger-name vendors, such as Dell and Compaq, failed to offer—especially the alternative processor socket and the external cache.

Performance on PC Labs' benchmark tests was mixed. The product's processor score was mainstream, but the memory score was well below average. Disk scores under both DOS and Windows were above average. The machine's graphics scores place it in the top ten under both DOS and Windows.

Comtrade's warranty is better than average with two years of coverage for parts and labor, including free on-site service during the first year.—OR

Data Storage Marketing Inc.

DataStor 486-25SX

The \$1,715 DataStor 486-25SX is a sturdy machine, judging from its metal construction. Its use of local-bus video gives the DataStor 486-25SX a performance boost, but the system wasn't configured as well as it could have been.

There's nothing out of the ordinary about this system, which makes its performance on PC Labs' tests surprising. The DataStor 486-25SX consistently performed near the top of the 486SX/25-based machines in this review.

The motherboard is an ECS model with a 486 coprocessor socket and ample space for maneuvering. Unfortunately, the company has not handled the real estate intelligently.

The memory banks, which hold 32K of RAM, are partially blocked by the power supply. Data Storage Marketing chose to use a multi I/O card: on the face of it, this seems like a good idea, since you can put all your ports on one card to save space. In this machine, however, it would have been smarter to put the I/O connections on the motherboard because the I/O card's ribbon wires are threaded in a way that leaves three 16-bit slots inaccessible.

A Genoa video card is on the proprietary local bus, but its placement hinders



FACT FILE

DataStor 486-25SX

Data Storage Marketing Inc., 5718 Central Ave. Boulder, CO 80301; 800-543-6098, 303-442-4747; fax, 303-442-7985

List price (tested configuration): \$1,715.

Memory and processor RAM cache: 4MB 60-ns SIMMs, 64K external cache

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, DFI MIO-400KF ISA-card disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Genoa VI-811/833 VESA local-bus-card video controller with 1MB DRAM, DataStor Spectra II 14-inch monitor with a 72-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The DataStor 486-25SX has a clumsy configuration that limits expandability, its components peg it as just an average machine

ON READER SERVICE CARD

access to the last slot. (Models with VESA-compliant local-bus slots were scheduled to ship in early 1993.) This leaves three slots open for expansion, but one of them will handle only half-length cards, because of the placement of the AMI BIOS.

The test scores revealed a few pleasant surprises. The best score was a stunning number-two ranking on the video test, most likely because of the local-bus video. Elsewhere, the scores pegged the DataStor as an average machine in comparison to the entire test group.

The included DataStor Spectra II 14-inch monitor is only adequate. Its highest noninterlaced resolution is 800 by 600. The unit comes with a two-year warranty on parts and labor. On-site service is available for a variable fee. Technical support is available toll-free or via Data Storage's bulletin board.—BG

Dell Computer Corp.

Dell System 486P/25

Dell Computer's low-cost entry seems aimed at the I-need-a-cheap-computer-to-do-just-this-one-thing crowd. With its slimline case and small motherboard, the \$1,948 Dell 486P/25 leaves little room for the expansion needed by users with varied requirements, but it provides all the basics needed for a more limited functionality.

This is not to say that the small-size Dell System 486P/25 can't be expanded; the system's motherboard has jumper switches for CPU speed and one empty half-height drive bay is left open. But the Dell has only three 16-bit expansion slots (compared to five on the slimline CompuAdd units, for example) and there is no secondary processor cache. This cache is crucial if you're going to get good results from those easy OverDrive upgrades. The absence of a cache is also somewhat strange in a system that just barely dips beneath the \$2,000 mark—many of its competitors managed to include one for that kind of money.

For users who don't need much growth from their systems, though, Dell's entry carries all the basics, including integrated video, I/O ports, and IDE drive controller circuitry. The usual Dell engineering details are also here, such as the removable heat sink on the processor and the easily upgradable video module, which held the maximum 1MB of video memory in our test unit. And you get Dell's famously detailed documentation and other sundries, although the monitor is a low-end model.

Performance was indicative of the low price—average or slightly below average across the board. Though solidly built and undoubtedly dependable, the Dell 486P/25 system is not designed to be a screamer. You can't really expect that kind of performance for this kind of price.

Dell System 486P/25

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Expandability **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair Service **ABOVE AVERAGE**

Tech Support **ABOVE AVERAGE**

DataStor 486-25SX

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Expandability **FAIR**



FACT FILE

Dell System 486P/25

Dell Computer Corp., 9505 Arboretum Blvd., Austin TX 78759; 800-289-3355, 512-338-4400; fax, 800-727-8320

List price (tested configuration): \$1,948

Memory and processor RAM cache: 4MB 80-ns SIMMs

Disk drives and controller: Conner CP30174E 17-ms 170MB IDE hard disk with 32K cache, integrated disk controller, 1.44MB floppy disk drive.

Display: Integrated video controller with 1MB DRAM. Dell VGA 800 14-inch monitor with a 60-Hz refresh rate at 800-by-600 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: This small computer from Dell is a merely mediocre offering. The appeal of the Dell System 486P/25 is strengthened only by Dell Computer Corp.'s reputation and the Dell System 486/P25's relatively low price tag.



ON READER SERVICE CARD

Dell's warranty remains at one year for parts and labor and on-site service.—OR

DFI Inc.

DFI Diamond Series Model 425SA

Although the \$1,750 Diamond Series Model 425SA from DFI has a very competitive price tag, the system is poorly designed and delivers average performance at best.

The location of components inside the cramped slimline case is a major design flaw. To provide expansion room, DFI installed a card with five 16-bit ISA slots (three on one side, two on the other) in the middle of the motherboard.

Unfortunately, the two slots on the side near the hard disk are blocked by device connector and controller cables.

This limits access for expansion to the three slots on the other side. That's about what you would find in an ordinary slimline case without the vertically mounted expansion slots.

The Diamond Series Model 425SA's motherboard integrates a large number of discrete components and features a socket for the Intel 80487 coprocessor. Unfortunately, the CPU is completely covered by the drive bay, making an upgrade difficult.

On PC Labs' benchmark tests, the Diamond Series Model 425SA generally performed below average. The Western Digital AC 120MB hard disk—which was much smaller than most of the others in this product roundup—turned in below-average Disk Winmark and DOS disk test scores.



FACT FILE

DFI Diamond Series Model 425SA

DFI Inc., 135 Main Ave., Sacramento, CA 95838; 916-568-1234; fax, 916-568-1233

List price (tested configuration): \$1,750

Memory and processor RAM cache: 4MB 80-ns SIMMs

Disk drives and controller: Western Digital AC 120 16-ms 120MB IDE hard disk with 32K cache, disk controller integrated on motherboard, 1.2MB and 1.44MB floppy disk drives

Display: Video controller with 1MB DRAM integrated on motherboard; ADI SM-5514A 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, QA Plus.

In short: Limited expansion, an awkward design, and poor performance prevent this PC from being a wise choice among low-cost slimlines.



ON READER SERVICE CARD

DFI Diamond Series 425SA

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR

As expected, the integrated Tseng Labs ET4000AX chip set performed well on the DOS video test and very poorly on the Graphics Winmark test. Included was an ADI 14-inch monitor that supported noninterlaced resolutions of as high as 1,024 by 768 at a 70-Hz refresh rate.

The exceptions to the below-average scores came on the memory test, where scores were slightly above average, and the video test, on which the DFI entry swung into the top ten. A DFI mouse comes bundled. DFI's warranty is one year for parts and labor and free on-site service.—William P. Flanagan

Diamond Technologies

DT 486DLC-40

Diamond Technologies' entry, based on a Cyrix CX486DLC/40 processor, is a low-cost winner with plenty of expansion slots, a large cached disk controller, and performance levels that for the most part are far above its competitors. The \$1,785 Diamond DT DLC-40 captured the number one spot on PC Labs' DOS disk test and placed second with its overall DOSmark score; the computer is a veritable powerhouse at running DOS software.

The high disk scores are attributable to the 213MB Maxtor hard disk, which is wired to a 16-bit S & A Lab DC-99M controller with 2.5MB of cache—something you will definitely not find in many below-\$2,000 systems. The unit posted a very strong Disk Winmark score, though the numbers were not as glowing as they were on the DOS disk test.

The DT's processor may be its weak spot. The Cyrix chip is substantially slower than many of the Intel chips found among the reviewed products. The Cyrix chip chalked up a processor score that was about dead center.

The DOS video score was weak, as expected from the S3 chip on the Diamond Computer Systems Stealth VRAM ISA

DT 486DLC-40

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR



FACT FILE

DT 486DLC-40

Diamond Technologies, 17165 Gillette Ave.,
Irvine CA 92714; 800-989-7253, 714-252-
1008; fax, 714-252-1508

List price (tested configuration): \$1,785.

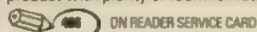
Memory and processor RAM cache: 4MB 60-ns
SIMMs, 256K external cache.

Disk drives and controller: Maxtor 7213AT 15-ms
213MB IDE hard disk with 64K cache, Promise Technol-
ogy DC-99M ISA-card disk controller with 2.5MB cache,
1.2MB and 1.44MB floppy disk drives.

Display: Diamond Computer Systems Stealth VRAM
ISA-card video controller with 1MB VRA; CTX CVP-
5468NI 14-inch monitor, 60-Hz at 1,024 by 768

Software: DOS 5.0, Microsoft Windows 3.1.

In short: With plenty of space for expansion and high-
quality internal components (including a disk controller
with a very large cache), the DT 486DLC-40 is a sound
product with plenty of room for future upgrades.



video card. This was balanced by impres-
sive Windows-based scores.

The rest of the bundled components
in the DT 486DLC-40 are average: a CTX
monitor with a maximum noninterlaced
resolution of 1,024 by 768 at a 60-Hz re-
fresh rate, a mouse, and bundled DOS
and Windows software.

The standard tower case contains a
system board with no integrated compo-
nents or provisions for modular upgrades
such as a faster processor or additional
external RAM cache memory beyond the
installed 256K.

Diamond's large, clearly written man-
ual aimed at beginners and separate sys-
tem-components manual are both nice
touches.

There is a two-year warranty on labor
and 15 months on parts, plus on-site ser-
vice from GE for \$75 during the first
year.—OR

Digital Equipment Corp.

DECpc 333sx LP

Digital Equipment Corp. can no longer
expect computer buyers to accept its high
prices as an inevitable part of buying a
"brand name," especially when Dell,
Compaq, and some lesser-known com-

*The DT 486DLC-40's
hard disk is wired to a 16-
bit controller with a 2.5MB
cache—something you will
definitely not find in many
below-\$2,000 systems.*

panies are offering more sophisticated
machines at nearly the same price.

The \$1,754 DECpc 333sx LP's qualifi-
cations as a bargain are tarnished right
off the bat because it uses an outdated
AMD AM386SXL/33 processor. While
this chip has its merits, prospective com-
puter purchasers with \$2,000 to spend
shouldn't really have to settle for any-
thing less than a 486SX/25.

Beyond that, the components inside
the unit were generally sound, but the
DEC machine achieved fairly low scores
on PC Labs' benchmark tests.

The case is well built but has the ex-
pansion limitations that are typical of a
slimline design. Although there are only
three slots, all of these 16-bit ISA slots
are open because the video and I/O ports
are integrated onto the DEC
motherboard.

Meanwhile,
only one 3.5-inch
drive bay is availa-
ble. And expan-
sion would be lim-
ited in any case by
the unit's 145-watt
power supply, far
less than the 200-
to 250-watt sup-
plies found in
most of the ma-

chines in this test group.

The DECpc 333sx LP didn't do well
on PC Labs' benchmark tests. The sole
exceptions were its DOS video and
Graphics Winmark scores. These results
are attributable to the Cirrus Logic video
chip set. The memory score was well be-
low average. The system's Quantum Pro-
drive 240MB hard drive fared about aver-
age on the disk test, but produced a
below-average result on the Disk Win-
mark rating.

Not suprisingly, the unit didn't turn in
outstanding scores in comparison to most
of the other systems on the processor test.
Surprisingly, though, the scores the ma-
chine turned in with the AMD
Am386SXL/33 chip were marginally bet-
ter than those from the units using the
Cyril Cx486SLC/25. DEC offers a one-
year warranty on parts and labor and one
year of free on-site service.—WPF



FACT FILE

DECpc 333sx LP

Digital Equipment Corp., 50 Nagog Park,
Acton, MA 01720; 800-722-9332; fax, 800-
524-5694

List price (tested configuration): \$1,754.

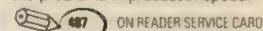
Memory and processor RAM cache: 4MB 70-ns
SIMMs, 64K external cache

Disk drives and controller: Quantum Prodrive
LPS240AT 16-ms 240MB IDE hard disk with 256K
cache, integrated disk controller, 1.2MB and 1.44MB
floppy disk drives.

Display: Integrated video controller with 1MB DRAM,
DEC PC7XV-CA 13-inch monitor with a 72-Hz refresh
rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The AMD 386 processor quickly drops the
DEC PC out of the running as a bargain among low-
cost computers, and the components do little to remedy
the problems in processor speed.



DECpc 333sx LP

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Expandability **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE
AVERAGE**

Repair Service **ABOVE
AVERAGE**

Tech Support **ABOVE
AVERAGE**

A DEMOCRAT IN THE WHITE HOUSE.

A WOMEN'S RESTROOM ON THE SENATE FLOOR.

IBM AND APPLE WORKING TOGETHER.

A TRUCE BETWEEN THE CRIPS AND BLOODS.

A DICTATOR WITH A GOOD COMPLEXION.

We're shattering some conventions ourselves. With products like the new WIN.PRO. Our first true color Windows accelerator for your VESA VL bus or ISA bus. We don't mean to sound braggadocian, but there's plenty more where that came from. Frankly, if Newsweek is smart, they'll reserve a cover for us.

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CIRCLE 066 ON READER SERVICE CARD

DTK Computer Inc.

Feat-3330

The \$1,995 Feat-3330 from DTK Computer is a no-nonsense system with features the average user needs, good performance, and expansion potential at a reasonable price.

The system gains points for design. The motherboard is cleanly built, with eight 16-bit expansion slots (six open) and provision for a Weitek coprocessor.

Although the case is not large, the interior is uncluttered and the user has unrestricted access to all of the major components, including the CPU, memory chip banks, and expansion slots.

The empty socket integrated on the motherboard is a nice touch. It's designed to house a crystal used when upgrading

the unit to a 486DX/50. A useful addition would have been a ZIF (zero-insertion-force) socket to allow easier upgrading of the main processor.

The system's DCM-1428 14-inch monitor, which supports maximum noninterlaced resolutions of 1,024-by-768 at a 70-Hz refresh rate, arrived with an antiglare screen and provided good color.

The Feat-3330 turned in respectable numbers on the PC Labs' benchmark tests. The Intel 486/33 CPU achieved a respectable rating on the processor test, while the memory test result was better than average because of the system's use of 4MB of 70-ns RAM combined with 64K of processor RAM cache.

The DOS disk test and Disk Winmark scores turned in by the 213MB Maxtor IDE hard disk with a 64K cache and the DTK ISA-card disk controller were average, as were the results of the DOS video test and the Graphics Winmark test. The documentation sent with the DTK unit was adequate.

DTK falls in line with the majority of the group by offering a one-year parts-and-labor warranty, with nationwide on-site service from GE for an extra \$29. The DTK Feat-3330 is an affordable and reliable system.—WPF

Expo Tech Inc.

Expo 486DX2/50

Expo Tech Inc.'s Expo 486DX2/50 packs a high-performance processor into a slim-line case. This setup limits the unit's internal expansion options, but the Expo did manage to turn in excellent numbers on PC Labs' benchmark tests. This high-level performance comes at a bargain price of \$1,999.

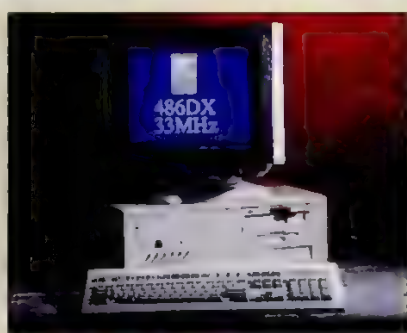
You'll find as much high-performance componentry in the Expo 486DX2/50 as the company could possibly cram inside the slim-line case without raising the unit's low price. Though this made for

nice benchmark test results, it also created a cable forest, limiting internal expandability or at least making it a bit of a

The Expo 486DX2/50 may be small, but compared with the other PCs in this review—most of which came with less-powerful CPUs—it's a real screamer.

chore. You'll also have some trouble accessing memory chips and other motherboard elements.

But after digging a little, you'll find components capable of handling most



FACT FILE

DTK Feat-3330

DTK Computer Inc., 17700 Castleton St., #300, City of Industry, CA 91748; 800-289-2385, 818-810-8880; fax, 818-810-3722

List price (tested configuration): \$1,995

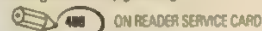
Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K external cache

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, DTK PTI-227B ISA-card disk controller, 1.2MB and 1 44MB floppy disk drives.

Display: DTK PTI-C31 ISA-card video controller with 1MB DRAM, DTK DCM-1428 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1

In short: The DTK Feat-3330A is a reliable, low-cost system with respectable performance and an interior designed for upgrading



FACT FILE

Expo Tech 486DX2/50

Expo Tech Inc., 113 McHenry Rd., Buffalo Grove, IL 60089; 800-284-3976; fax, 800-947-3976

List price (tested configuration): \$1,999

Memory and processor RAM cache: 4MB 70-ns SIMMs, 128K external cache

Disk drives and controller: Seagate ST3283A 12-ms 245MB IDE hard disk with 128K cache, IDE controller, 1.2MB and 1.44MB floppy disk drives.

Display: Boca Research AVGA3 ISA-card video controller with 1MB DRAM, GoldStar 1465+ 14-inch monitor with a 87-Hz refresh rate at 1,024 by 768

Software: DOS 5.0, Microsoft Windows 3.1, Microsoft Works for Windows 2.0, Central Point Anti-Virus, Third Degree diagnostic software, 9600-/2400-bps fax modem

In short: This PC leaves little room for expansion, but turned in top-notch benchmark test results





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► SUMMARY OF FEATURES

Low-Cost PCs

List price (PC Magazine configuration) For this review of low-cost computers, we requested a configuration that included 4MB of RAM, a 200MB hard disk, a Super VGA color display capable of at least 800-by-600 resolution with 256 simultaneous colors, and one parallel and two serial ports. DOS 5.0 and Microsoft Windows 3.1 had to be preinstalled for testing purposes. Unless otherwise noted, all table entries refer to the range of options available in the systems reviewed.

Dealers/Direct-distribution channel Various machines are sold directly through mail order, through dealers, or, increasingly, through company-owned stores and superstores. *PC Magazine* views a 15 percent discount off the suggested retail price as typical.

The **chip set manufacturer** makes the logic that connects the CPU with the other functions managed by the system board.

The **processor upgrade path** indicates whether the PC has a standard, ZIF (zero-insertion-force), or LIF (low-insertion-force) socket, or whether you must use a processor card to perform an upgrade.

The **BIOS version (or date)** can affect the system's performance on PC Magazine Labs' benchmark tests. A machine with another BIOS may perform differently.

Flash memory contains BIOS code that can be updated via software. The BIOS is generally stored in conventional ROM, which has no provision for modification.

Installable RAM indicates the amount of memory that can be installed using any combination of chips and proprietary cards.

Cache architecture A four-way set-associative cache, native to the 486's internal 8K cache, divides data into four equal blocks; it is considered the most effective type of cache. A two-way set-associative cache's data is split into two equal blocks, and the data in a direct-mapped cache (the most common and least costly type) is not divided.

Cache write design A write-back design can cache data read from and written to memory. This method is theoretically superior to that of a posted write-through cache, which buffers all writes until the memory system bus is free before completing them; and that of a write-through cache, in which only reads from memory are cached.

Accessible drive bays can be reached from the system's front panel and can support removable media (such as tape and CD-ROMs); **internal drive bays** can be reached only by opening the case. We report the maximum number of accessible and internal drives the system can hold.

Floppy disk drives indicates the types of floppy disk drives the base-priced system contains. A dual floppy disk drive combines a 1.2MB and a 1.44MB unit inside a single drive bay.

Hard disk options We report the range of hard disk capacities the vendor offers for each system.

Disk controller location A computer with IDE (integrated drive electronics) circuitry has its controller functions integrated into the drive and motherboard but may have a separate controller.

Expansion bus For each type of expansion slot—8-bit, 16-bit, 32-bit, VESA, PCI, and proprietary—we report the number of slots on the motherboard. We

also indicate how many parallel, serial, and mouse ports are integrated onto the motherboard.

The **display circuitry** can reside on an expansion card or on the PC's motherboard. Motherboard circuitry is often faster, but if it cannot be disabled there is no way to upgrade it. For systems that use local-bus video, we indicate whether it is VESA-compliant or proprietary.

The **video chip set manufacturer** makes the logic that runs the video adapter.

DOS 5.0 and Microsoft Windows 3.1 are often bundled with the vendors' systems. Where the features table indicates a *no* answer, this software may be available from the same vendor at an additional cost. In such cases, you can consult each product's fact file to determine whether the price cited for the *PC Magazine* configuration includes DOS and Windows.

Other bundled software—beyond DOS and Windows—might include disk-caching software (such as SMARTDRV.SYS), expanded-memory-management software (such as QEMM-386), and any other free applications. Our table indicates whether or not any software is included with each system, free of charge; for specifics, consult the fact file for the individual computer.

The **first-year on-site service charge** is sometimes included in the price of the system.

FCC Class B identification number Systems with a Class B rating from the Federal Communications Commission have sufficiently low radio-frequency emissions to be used in the home. To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service, at 301-725-1072.

power-hungry applications. The components include a 128K external processor cache, Boca Research's AVGA3 ISA-card video controller with 1MB DRAM, a speedy Seagate hard disk, and GoldStar's serviceable 1465+ monitor, which supports noninterlaced resolutions of up to 1,024 by 768 at an 87-Hz refresh rate. Out of the four external and one internal drive bays, only

two are left open—one 5.25-inch external bay and one 3.5-inch external bay..

The system's stellar benchmark-test performance included top-10 DOS processor and memory scores. All other results landed within the top 20 or 25 of the products reviewed in this roundup.

For Windows users, the results were particularly impressive: the Graphics Winmark

score was in the top third, and the Disk Winmark numbers took first place, thanks to the Seagate 245MB IDE hard disk with 128K cache.

The Expo 486DX2/50 may be a rather small computer, but compared to the other low-cost computers in this review group—most of which came with less-powerful CPUs—it's a real screamer.

Expo Tech's warranty consists of one-year parts and labor with free on-site service for the first year.—OR

► Expo 486DX2/50	
SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD

There's a lot of talk about speeding up Windows.



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Epson's® new Progression™ PC makes Windows™ race so fast (up to ten times faster), you have to see it to believe it.

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For a free video that dramatically proves how you can race through Windows without costly and complicated accelerator cards, call **1-800-BUY EPSON**.

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Desktops



Dot Matrix



Notebooks



Lasers



Servers

COVER STORY
Low-Cost PCs

► **S U M M A R Y O F F E A T U R E S**

Low-Cost PCs



Products listed in alphabetical order	Acer Acros 486SX/25	ACMA 486/33i	AGA-DX33	ALR Flyer RS170 4/25s	Altec 486/33 ISA Local Bus	Amax 486DX2/50 ISAmix Power Station
■ = YES □ = NO						
List price (PC Magazine configuration)	\$1,799	\$1,948	\$1,965	\$1,848	\$1,929	\$1,995
Hard disk capacity	213MB	170MB	212MB	170MB	210MB	210MB
Dealers/Direct-distribution channel	■ □	■ ■	□ ■	■ ■	□ ■	■ □
Case style	Small-footprint	Small-footprint	Mini-tower	Slimline	Desktop	Tower
Bus architecture	ISA	ISA	ISA	ISA	ISA	ISA
Power supply (and number of connectors)	145 watts (5)	250 watts (4)	230 watts (5)	150 watts (4)	230 watts (5)	250 watts (5)
Motherboard and CPU						
Motherboard manufacturer	ALI	Helm Engineering	Agatech	ALR	Giga-Byte	Impression
Chip set manufacturer	Acer	SIS	Contaq	UMC	UMC	SIS
Processor upgrade path	Standard socket	Standard socket	Standard socket	Processor card	Standard socket	Standard socket
BIOS version (or date)	Acer 1.2R1.2	AMI (5/5/91)	AMI (12/12/91)	Phoenix (4/19/90)	AMI (12/12/91)	AMI (5/5/91)
Flash memory	■	□	□	■	□	□
Weitek/Cyrix coprocessor socket	□	■	■	□	■	■
Memory and Processor RAM Cache						
Installable RAM	4MB-64MB	1MB-32MB	1MB-32MB	4MB-36MB	1MB-32MB	1MB-32MB
External RAM cache	N/A	64K-256K	128K-256K	N/A	64K-256K	64K-256K
Cache architecture	N/A	Direct-mapped	Four-way set-associative	N/A	Direct-mapped	Direct-mapped
Cache write design	N/A	Write-back	Write-back	N/A	Write-back	Write-back
Disk Drives						
Accessible drive bays (5.25", 3.5")	2, 1	2, 1	3, 1	1, 1	3, 2	4, 0
Internal drive bays (5.25", 3.5")	0, 1	1, 0	1, 2	0, 1	None	2, 2
Floppy disk drives	1.2MB, 1.44MB	Dual	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
Hard disk options	0-200MB	52MB-1.2GB	40MB-1.2GB	80MB-535MB	130MB-540MB	40MB-2.1GB
Disk controller location	Motherboard	ISA card	ISA card	Motherboard	ISA card	ISA card
Expansion Bus						
8-bit, 16-bit, 32-bit slots	0, 4, 0	1, 7, 0	0, 8, 0	0, 4, 2	1, 5, 0	0, 7, 1
VESA, PCI, proprietary local-bus slots	None	None	None	None	0, 0, 2	None
Parallel, serial, mouse ports on motherboard	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	2, 2, 0
Integrated network adapter option	None	None	None	None	None	None
Video						
Display circuitry location	Motherboard	ISA card	ISA card	Motherboard	Proprietary local-bus card	ISA card
Video chip set manufacturer	Cirrus	S3	WD	WD	Tseng	ATI
Software						
DOS 5.0/Microsoft Windows 3.1	■ ■	■ ■	■ ■	□ □	■ ■	■ □
Other bundled software	■	■	□	□	□	□
Miscellaneous						
Warranty	1 year	1 year	1 year	1 year	2 years on parts, lifetime on labor	1 year
First year on-site service charge	Included	Included	Included	\$9.95	Included	\$69
FCC Class B identification num ber	GQ8PZ25D	IR7ACMA486G	IU7TMIB40503325E	EZYER32486SX-25	GHGALTEC433M	FKCAMAX486K

N/A—Not applicable. The product does not have this feature.

AIR—Advanced Integrated Research Inc., ALI—Acer Labs Inc., AMI—American Megatrends Inc., Asus—Asus Tek Computer Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elite Group Computer Systems Inc., ERI—EMPaC Research Inc., SIS—Silicon Integrated Systems Corp., SSI—Silicon Star International, TI—Texas Instruments Inc., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital.

COVER STORY
Low-Cost PCs

CONTINUES

American Mitac D4033	American Super Computer ASC 486/i33	Ares 486-25SX VL-Bus	Ariel 486SX-25 Best Value	Austin 486/DX2-50 WinStation	BSI 486DX2-50	C ² Saber 486/SLC	Clover 486-SXC
\$1,995	\$1,988	\$1,995	\$1,999	\$1,990	\$1,888	\$2,075	\$1,395
213MB	212MB	210MB	213MB	200MB	213MB	210MB	213MB
■ □	■ ■	□ ■	□ ■	■ ■	■ ■	■ ■	□ ■
Small-footprint	Mini-tower	Desktop	Mini-tower	Small-footprint	Tower	Small-footprint	Small-footprint
ISA	ISA	ISA	ISA	ISA	ISA	ISA	ISA
200 watts (5)	200 watts (5)	250 watts (5)	250 watts (6)	200 watts (4)	200 watts (5)	200 watts (5)	200 watts (5)

Agatech	ERI	Micronics	Micronics	Austin	BSI	ERI	Asina
Contaq	Symphony	Micronics	Micronics	SIS	OPTi	Symphony	ALI
Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	None	None
AMI (12/12/91)	AMI (7/7/92)	Phoenix (8/19/92)	Phoenix 0.10-G20-2	AMI (12/12/91)	AMI (8/31/91)	AMI (7/7/91)	AMI (7/7/91)
□	□	■	□	■	□	□	□
■	■	□	□	□	□	□	■

1MB-32MB	1MB-32MB	4MB-64MB	1MB-64MB	1MB-32MB	1MB-32MB	5MB-16MB	1MB-32MB
64K-512K	64K-1MB	N/A	N/A	64K-256K	64K-256K	N/A	N/A
Direct-mapped	Direct-mapped	N/A	N/A	Direct-mapped	Direct-mapped	N/A	N/A
Write-back	Write-through	N/A	N/A	Write-back	Write-back	N/A	N/A

3, 1	2, 2	2, 2	4, 0	3, 0	3, 2	3, 1	3, 2
0, 2	0, 1	0, 2	2, 0	0, 2	0, 2	0, 2	0, 1
1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
40MB-1.2GB	40MB-540MB	85MB-1.2GB	127MB-520MB	40MB-1.2GB	40MB-1.5GB	42MB-1.2GB	200MB
ISA card	ISA card	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card

0, 8, 0	2, 6, 0	0, 6, 0	0, 8, 0	1, 6, 0	0, 8, 0	0, 7, 0	2, 5, 0
None	None	2, 0, 0	None	0, 0, 1	None	None	None
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
None	None	None	None	None	None	None	None

ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card
Cirrus	Tseng	WD	WD	S3	WD	WD	AcuMos

■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
□	□	□	■	■	□	□	■

1 year	2 years	2 years on parts, lifetime on labor	1 year	1 year	1 year	1 year	1 year
\$99	\$150	Included	\$50	Included	N/A	Included	\$50
IU7D4033E-FGH	EUNLE0486DX-33SC	I8I486LB	IWS486SX25CMB	None	INRAMPT486	JDN486-S	JVGUS25DSC

COVER STORY
Low-Cost PCs

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order							
■ = YES □ = NO	Comex 486SX/25 VESA	Comp & Soft CS 486/33C256	Compaq ProLinea 4/33	CompuAdd 425SLC Low Profile	CompuAdd Express 440DLC Scalable	Comtrade 486 VESA Local Bus WinStation	
List price (PC Magazine configuration)	\$1,995	\$1,995	\$2,250	\$1,703	\$1,894	\$1,945	
Hard disk capacity	200MB	213MB	240MB	170MB	170MB	213MB	
Dealers/Direct-distribution channel	■ ■	■ □	■ □	■ ■	□ ■	□ ■	
Case style	Small-footprint	Mini-tower	Slimline	Slimline	Slimline	Tower	
Bus architecture	ISA	ISA	ISA	ISA	ISA	ISA	
Power supply (and number of connectors)	220 watts (4)	200 watts (5)	146 watts (4)	150 watts (5)	150 watts (5)	230 watts (4)	
Motherboard and CPU							
Motherboard manufacturer	Micronics	American Digicom	Compaq	CompuAdd	BCM/CompuAdd Express	UMC	
Chip set manufacturer	C&T/Micronics	Symphony	VLSI	C&T	OPTi	UMC	
Processor upgrade path	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	
BIOS version (or date)	Phoenix (10/1/92)	AMI (7/7/91)	Compaq (10/6/92)	C&T 2.3.6	AMI (12/12/91)	AMI (7/1/92)	
Flash memory	■	□	□	□	□	□	
Weitek/Cyrix coprocessor socket	□	□	□	□	□	■	
Memory and Processor RAM Cache							
Installable RAM	4MB-32MB	1MB-32MB	4MB-32MB	1MB-16MB	4MB-32MB	4MB-32MB	
External RAM cache	64K-256K	64K-256K	N/A	N/A	128K	64K-256K	
Cache architecture	Direct-mapped	Direct-mapped	N/A	N/A	Direct-mapped	Direct-mapped	
Cache write design	Write-through	Write-through	N/A	N/A	Write-back	Write-back	
Disk Drives							
Accessible drive bays (5.25", 3.5")	2, 1	3, 2	1, 1	1, 1	1, 1	3, 3	
Internal drive bays (5.25", 3.5")	1, 1	2, 1	0, 2	0, 1	1, 1	0, 1	
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	Dual	Dual	1.2MB, 1.44MB	
Hard disk options	80MB-1.2GB	40MB-4GB	120MB-240MB	120MB-200MB	80MB-340MB	40MB-1GB	
Disk controller location	Motherboard	ISA card	Motherboard	Motherboard	Motherboard	ISA card	
Expansion Bus							
8-bit, 16-bit, 32-bit slots	0, 8, 0	2, 6, 0	0, 3, 0	2, 3, 0	2, 3, 0	2, 5, 2	
VESA, PCI, proprietary local-bus slots	2, 0, 0	None	None	None	None	0, 0, 1	
Parallel, serial, mouse ports on motherboard	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	
Integrated network adapter option	None	None	None	None	None	None	
Video							
Display circuitry location	VESA local-bus card	ISA card	Motherboard	Motherboard	Motherboard	Proprietary local-bus card	
Video chip set manufacturer	Tseng	WD	Tseng	WD	Tseng	S3	
Software							
DOS 5.0/Microsoft Windows 3.1	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
Other bundled software	□	□	□	■	□	□	
Miscellaneous							
Warranty	2 years	1 year	1 year	1 year on parts, 2 years on labor	1 year	2 years	
First year on-site service charge	Included	\$129	Included	\$90	Included	Included	
FCC Class B identification number	None	EXK6SCPC-486	CNT75MBF5	JE5325SXLP-1	JE5490DLCLP-2	KDI486WINSTATION	

N/A—Not applicable: The product does not have this feature

AIR—Advanced Integrated Research Inc., ALI—Acer Labs Inc., AMI—American Megatrends Inc., Asus—Asus Tek Computer Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elite Group Computer Systems Inc., ERI—EMPaC Research Inc., SIS—Silicon Integrated Systems Corp., SSI—Silicon Star International, TI—Texas Instruments Inc., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital

COVER STORY
Low-Cost PCs

CONTINUES

DataStor 486-25SX	Dell System 486P/25	DFI Diamond Series Model 425SA	Diamond DT 486DLC-40	Digital DECpc 333sx LP	DTK FEAT-3300	Expo 486DX2/50	FastData 486/33+
\$1,715	\$1,948	\$1,750	\$1,785	\$1,754	\$1,995	\$1,999	\$1,999
213MB	170MB	120MB	213MB	245MB	213MB	245MB	213MB
■ ■	■ ■	■ □	□ ■	■ ■	■ □	■ ■	□ ■
Small-footprint	Slimline	Slimline	Tower	Slimline	Desktop	Slimline	Small-footprint
ISA	ISA	ISA	ISA	ISA	ISA	ISA	ISA
230 watts (4)	146 watts (5)	200 watts (4)	230 watts (5)	145 watts (5)	200 watts (5)	183 watts (6)	200 watts (4)

ECS	Dell	DFI	ASA	Digital	DTK	Vtech	ECS
UMC	VLSI	UMC	Forex	ETEQ	Symphony	Vtech	UMC
Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket
AMI (7/16/92)	Phoenix (9/22/92)	AMI (7/7/91)	AMI (12/12/91)	Phoenix 1.3	DTK 4.27	AMI/Vtech (8/1/92)	AMI (6/1/91)
□	■	□	□	■	□	□	□
□	□	■	■	□	■	■	■

1MB-32MB	4MB-64MB	1MB-16MB	1MB-32MB	2MB-14MB	1MB-32MB	4MB-32MB	1MB-32MB
64K-256K	N/A	N/A	64K-256K	64K	64K-256K	128K	64K-1MB
Direct-mapped	N/A	N/A	Direct-mapped	Direct-mapped	Direct-mapped	Four-way set-associative	Four-way set-associative
Write-back	N/A	N/A	Write-back	Write-through	Write-through	Write-back	Write-back

2, 1	1, 1	2, 1	3, 2	1, 1	3, 2	2, 2	3, 2
1, 0	0, 1	0, 1	1, 3	0, 2	0, 1	0, 1	0, 2
1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
80MB-1.2GB	80MB-500MB	120MB-800MB	80MB-1.2GB	52MB-426MB	84MB-240MB	245MB-426MB	170MB-1.3GB
ISA card	Motherboard	Motherboard	ISA card	Motherboard	ISA card	Motherboard	ISA card

1, 7, 0	0, 3, 0	0, 5, 0	0, 8, 0	0, 3, 0	0, 8, 0	0, 6, 0	1, 7, 0
0, 0, 1	None	None	None	None	None	None	None
1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 0
None	None	None	None	None	None	None	None

VESA local-bus card	Motherboard	Motherboard	ISA card	Motherboard	ISA card	ISA card	ISA card
Tseng	WD	Tseng	S3	Cirrus	WD	Cirrus	WD

■ ■	□ □	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
□	□	■	□	□	□	■	■

2 years	1 year	1 year	2 years on parts, 15 months on labor	1 year	1 year	1 year	1 year
\$150	Included	Included	\$75	Included	\$29	Included	Included
HZE486-25SX	E2K486P	E5Y486UNBAIO	JHT911938640	A09PC731	F825K4GRAFIKA4C	IFS80-2535-1	IUT486SDJ



POWERFUL



\$1799 Hyundai
425S

- 25MHz Intel 486SX w/8KB integrated cache
- 32-bit VESA Local Bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Upgradable to 486DX power via Intel Overdrive™
- 4MB system memory expandable to 64MB on board
- 80MB 17ms IDE HDD, 32KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs

- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 25/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2-button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
- Other hard drive, video, memory, and monitor options available



\$2369 Hyundai
433D

- 33MHz Intel 486DX w/8KB integrated cache
- 32-bit VESA Local Bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Processor upgradable via ZIF socket
- 4MB system memory expandable to 64MB on board
- 200MB 12ms IDE HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs
- 14" non-interlaced, ultra-high resolution, .28 dot

- pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 25/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2-button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
- Available in floor-standing server model as 433DT, call for price
- Other hard drive, video, memory, and monitor options available



\$2599 Hyundai
450D2

- 50MHz Intel 486DX2 w/8KB integrated cache
- 32-bit VESA Local Bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Processor upgradable via ZIF socket
- 8MB system memory expandable to 64MB on board
- 200MB 12ms IDE HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs

- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 25/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2-button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
- Other hard drive, video, memory, and monitor options available



\$2995 Hyundai
466D2

- 66MHz Intel 486DX2 w/8KB integrated cache
- 32-bit VESA Local Bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Processor upgradable via ZIF socket
- 8MB system memory expandable to 64MB on board
- 360MB 12ms IDE HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs
- 14" non-interlaced, ultra-high resolution, .28 dot

- pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 25/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2 button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
- Available in floor-standing model with ISA architecture as 466D2T, call for price
- Other hard drive, video, memory, and monitor options available

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Your Name _____ Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone() _____ FAX() _____

Number of PCs in your current site _____ Brands you have standardized on _____

Other brands you are considering _____

Number of PCs installed 486 _____ 386 _____ 386SX _____ 286 _____

Tell us about your targeted system configuration

CPU Type ☐ 486 ☐ 486SX ☐ 386DX ☐ 386SX ☐ Notebook

Architecture ☐ ISA ☐ EISA

Memory _____ MB installed Cache Memory ☐ 128 KB ☐ 256KB

Floppies ☐ 1.44MB 3-1/2" ☐ 1.2MB 5-1/4"

Hard Disks (IDE) ☐ 100MB ☐ 120MB ☐ 200MB ☐ 250MB ☐ 330MB ☐ 500MB

(SCSI) 3.5" ☐ 360MB ☐ 540MB ☐ 1.2GB

5.25" ☐ 330MB ☐ 760MB ☐ 1.6GB ☐ 2.0GB

☐ Tape _____ MB ☐ Sound Card ☐ Other _____ ☐ Fax/Modem ☐ CD-ROM

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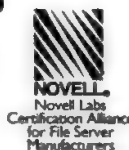
PCM118

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CIRCLE 275 ON READER SERVICE CARD

COVER STORY
Low-Cost PCs

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order							
	Gateway 2000 4DX-33	Gecco 4DX-33	Hewlett Rand HR 486SX-25C	Hewlett- Packard HP Vectra 486/25N	HiQ Ultimate 433I	Hyundai 433S	
	■ = YES □ = NO						
List price (PC Magazine configuration)	\$1,995	\$1,995	\$1,998	\$2,138	\$1,799	\$1,949	
Hard disk capacity	200MB	200MB	200MB	170MB	213MB	170MB	
Dealers/Direct-distribution channel	□ ■	□ ■	■ □	■ □	■ ■	■ ■	
Case style	Slimline	Desktop	Mini-tower	Slimline	Tower	Small-footprint	
Bus architecture	ISA	ISA	ISA	ISA	ISA	ISA	
Power supply (and number of connectors)	200 watts (8)	220 watts (4)	200 watts (5)	80 watts (2)	250 watts (5)	200 watts (6)	
Motherboard and CPU							
Motherboard manufacturer	Gateway	Koutech	Hewlett Rand	HP	HiQ	Hyundai	
Chip set manufacturer	OPTi	OPTi	Symphony	VLSI	OPTi	OPTi	
Processor upgrade path	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	ZIF socket	
BIOS version (or date)	Phoenix 1.01	AMI (4/4/92)	AMI (7/7/91) (8/3/92)	Phoenix/HP	AMI (6/6/91)	AMI (6/6/92)	
Flash memory	■	□	□	■	□	□	
Weitek/Cyrix coprocessor socket	□	□	■	□	■	□	
Memory and Processor RAM Cache							
Installable RAM	4MB-64MB	4MB-32MB	1MB-32MB	4MB-48MB	1MB-32MB	4MB-64MB	
External RAM cache	64K-256K	64K-256K	64K-1MB	N/A	64K-256K	128K-256K	
Cache architecture	Two-way set-associative	Direct-mapped	Direct-mapped	N/A	Direct-mapped	Direct-mapped	
Cache write design	Write-through	Write-back	Write-back	N/A	Write-back	Write-back	
Disk Drives							
Accessible drive bays (5.25", 3.5")	1, 1	2, 2	2, 2	0, 2	4, 0	3, 2	
Internal drive bays (5.25", 3.5")	1, 0	0, 2	0, 1	None	0, 3	0, 2	
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	
Hard disk options	80MB-500MB	80MB-1.2GB	60MB-1.2GB	85MB-170MB	80MB-2GB	120MB-540MB	
Disk controller location	Motherboard	ISA card	ISA card	Motherboard	ISA card	Motherboard	
Expansion Bus							
8-bit, 16-bit, 32-bit slots	0, 5, 0	2, 6, 0	0, 7, 1	0, 3, 0	0, 7, 0	0, 7, 0	
VESA, PCI, proprietary local-bus slots	None	None	None	None	1, 0, 0	1, 0, 0	
Parallel, serial, mouse ports on motherboard	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 1	
Integrated network adapter option	None	None	None	None	None	None	
Video							
Display circuitry location	Motherboard	ISA card	ISA card	Motherboard	ISA card	VESA local-bus card	
Video chip set manufacturer	WD	ATI	Trident	S3	Tseng	S3	
Software							
DOS 5.0/Microsoft Windows 3.1	■ ■	■ ■	□ □	■ ■	■ ■	■ ■	
Other bundled software	□	□	□	□	□	□	
Miscellaneous							
Warranty	1 year	2 years	7 years on parts, 1 year on labor	1 year	1 year on parts, 2 years on labor	18 months	
First year on-site service charge	Included	Included	\$69	Included	Included	Included	
FCC Class B identification number	HWYLP48612	IJWKS486	ILDHR486	B94VECTRA486-XXN	IYBE688	IOR-HEA-433D	

N/A—Not applicable: The product does not have this feature.

AIR—Advanced Integrated Research Inc., ALI—Acer Labs Inc., AMI—American Megatrends Inc., Asus—Asus Tek Computer Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elite Group Computer Systems Inc., ERI—EMPac Research Inc., SIS—Silicon Integrated Systems Corp., SSI—Silicon Star International, TI—Texas Instruments Inc., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital.

COVER STORY
Low-Cost PCs

CONTINUES

IBM PS/1 2155-G44	Image 486DX-33	Insight 486-33i Cache	Int. Instr. Blue Max Monolith 4250 DIUL	KEY486-33 ISA	LodeStar 486DLC-33	Mega Impact 486SX/25+	MicroFLEX 486/DX2/50
\$1,999	\$1,995	\$1,999	\$2,115	\$1,995	\$1,999	\$1,550	\$1,995
170MB	213MB	200MB	170MB	213MB	213MB	213MB	200MB
■ □	□ ■	□ ■	■ ■	■ ■	■ ■	■ ■	□ ■
Small-footprint	Mini-tower	Tower	Mini-tower	Tower	Small-footprint	Small-footprint	Small-footprint
ISA	ISA	ISA	ISA	ISA	ISA	ISA	ISA
95 watts (4)	230 watts (5)	250 watts (5)	250 watts (6)	250 watts (6)	200 watts (5)	220 watts (4)	200 watts (5)

IBM	Ampttron	Aten	Int. Instr.	Asus	J-Mark	BCM	Forex
VLSI	OPTi	UMC, Unichip	SIS, Unichip	SIS	OPTi	SIS	Forex/SIS
Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	None	Standard socket
IBM 33G6889-90	AMI (7/19/91)	AMI (12/12/91)	AMI (12/12/91)	AMI (5/5/91)	AMI (7/7/91)	AMI (12/12/91)	AMI (12/12/91)
□	□	□	□	□	□	□	□
□	□	■	□	■	■	□	□

4MB-32MB	1MB-32MB	4MB-32MB	1MB-128MB	1MB-64MB	1MB-32MB	1MB-32MB	1MB-32MB
N/A	64K-256K	64K-256K	64K-256K	64K-256K	64K-256K	128K-256K	64K-256K
N/A	Direct-mapped	Four-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
N/A	Write-back	Write-back	Write-through	Write-through	Write-through	Write-back	Write-back

1, 1	3, 2	6, 0	2, 2	5, 2	3, 1	2, 1	3, 1
1, 1	0, 2	None	1, 0	1, 0	0, 3	1, 1	0, 1
1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
85MB-211MB	105MB-2GB	40MB-2.1GB	40MB-2.2GB	80MB-650MB	40MB-2.2GB	80MB-2GB	80MB-1.7GB
Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card

0, 5, 0	0, 8, 0	2, 6, 0	2, 5, 0	1, 7, 0	0, 8, 0	1, 6, 0	0, 8, 0
None	None	None	0, 0, 1	None	0, 0, 1	0, 0, 1	None
1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
None	None	None	None	None	None	None	None

Motherboard	ISA card	ISA card	Proprietary local-bus card	ISA card	ISA card	Proprietary local-bus card	ISA card
Tseng	WD	WD	Tseng	ATI	WD	Tseng	ATI

■ ■	■ ■	■ ■	□ □	■ ■	■ ■	■ ■	■ ■
□	□	■	□	■	□	□	□

1 year	1 year on parts, 2 years on labor	1 year	1 year	18 months	2 years on parts, lifetime on labor	1 year	2 years
N/A	N/A	N/A	Included	Included	Included	N/A	\$50
ANO2155-02	INRAMPT486	J9DG1000	None	JTFDATA486SF	JCKGA-486	None	GXUMICROFLEX

COVER STORY
Low-Cost PCs

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO

	Mitsuba Pro Upgradable- 4SX/25	MSE 486EISA- 50MHz	National Microsystems Flash 486DX2-50 LB	NCR System 3230	NEC Ready 425 System	NETiS Ultra WinStation N433L
List price (PC Magazine configuration)	\$1,995	\$1,995	\$1,995	\$2,000	\$1,998	\$1,790
Hard disk capacity	213MB	213MB	213MB	240MB	170MB	213MB
Dealers/Direct-distribution channel	■ □	□ ■	□ ■	■ ■	■ □	■ ■
Case style	Small-footprint	Small-footprint	Mini-tower	Slimline	Slimline	Small-footprint
Bus architecture	ISA	EISA	ISA	ISA	ISA	ISA
Power supply (and number of connectors)	200 watts (5)	200 watts (4)	200 watts (5)	150 watts (3)	145 watts (4)	200 watts (5)

Motherboard and CPU

Motherboard manufacturer	Mitsuba	Asutek	AIR	NCR	NEC	NETiS
Chip set manufacturer	SIS	SIS	UMC	UMC	C&T	Unichip
Processor upgrade path	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket
BIOS version (or date)	AMI (12/12/91)	Award 4.0	AMI (12/12/91)	NCR 1.00.01	Phoenix 1.01.03	AMI (12/12/91)
Flash memory	■	□	□	□	■	□
Weitek/Cyrix coprocessor socket	□	□	■	□	□	□

Memory and Processor RAM Cache

Installable RAM	1MB-32MB	4MB-128MB	1MB-64MB	4MB-32MB	4MB-64MB	1MB-128MB
External RAM cache	0-256K	64K-256K	64K-256K	0-256K	N/A	64K-256K
Cache architecture	Direct-mapped	Two-way set-associative	Direct-mapped	Direct-mapped	N/A	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-back	N/A	Write-back

Disk Drives

Accessible drive bays (5.25", 3.5")	3, 0	3, 2	3, 2	1, 1	1, 1	3, 1
Internal drive bays (5.25", 3.5")	0, 1	None	0, 2	1, 1	0, 1	0, 1
Floppy disk drives	1.2MB, 1.44MB	Dual	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
Hard disk options	42MB-1GB	200MB-2GB	40MB-1.7GB	80MB-240MB	170MB	42MB-520MB
Disk controller location	ISA card	ISA card	ISA card	Motherboard	Motherboard	ISA card

Expansion Bus

8-bit, 16-bit, 32-bit slots	1, 6, 0	0, 5, 3	1, 7, 0	0, 4, 0	0, 3, 0	8, 5, 0
VESA, PCI, proprietary local-bus slots	0, 0, 1	None	0, 0, 1	None	None	0, 0, 1
Parallel, serial, mouse ports on motherboard	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 1	1, 1, 1	1, 2, 0
Integrated network adapter option	None	None	None	None	None	None

Video

Display circuitry location	Proprietary local-bus card	ISA card	Proprietary local-bus card	Motherboard	Motherboard	Proprietary local-bus card
Video chip set manufacturer	Tseng	WD	S3	Cirrus	Cirrus	Tseng

Software

DOS 5.0/Microsoft Windows 3.1	■ □	■ ■	■ ■	■ ■	■ ■	■ ■
Other bundled software	□	□	□	□	■	□

Miscellaneous

Warranty	1 year	1 year	15 months on parts, 2 years on labor	2 years	1 year	1 year
First year on-site service charge	Included	N/A	\$50	Included	Included	\$80
FCC Class B identification number	C9MSM01	JL7EISA486-50/25-50	JDQ820AB66	CTD3230	B7ZA6KS	JVSN486C

N/A—Not applicable. The product does not have this feature

AIR—Advanced Integrated Research Inc., ALI—Acer Labs Inc., AMI—American Megatrends Inc., Asus—Asus Tek Computer Inc., BCM—BCM Advanced Research Inc., C&T—Chins & Technologies Inc., ECS—Elite Group Computer Systems Inc., ERI—EMPaC Research Inc., SIS—Silicon Integrated Systems Corp., SSI—Silicon Star International, TI—Texas Instruments Inc., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital

COVER STORY
Low-Cost PCs

CONTINUES

Occidental 33MHz 486DX	PC Brand Leader 486/DLC-33	Poly 486-50i	QSI Klonimus 486/SX25	Qtech PC-4D33-4	SST 386-40 MWC	Standard 486SX/25	Swan 486SX/25 V
\$1,995	\$1,945	\$1,998	\$1,976	\$1,999	\$1,890	\$1,895	\$1,995
240MB	245MB	213MB	213MB	213MB	212MB	213MB	213MB
□ ■	■ ■	■ ■	■ ■	□ ■	■ ■	□ ■	□ ■
Small-footprint	Slimline	Small-footprint	Desktop	Small-footprint	Small-footprint	Small-footprint	Small-footprint
ISA	ISA	ISA	ISA	ISA	ISA	ISA	ISA
200 watts (8)	200 watts (5)	200 watts (5)	200 watts (4)	200 watts (5)	200 watts (5)	200 watts (4)	200 watts (4)

Occidental	PC Brand	Polywell	AIM	Mycomp	TMC	SSI	ECS
VLSI	Symphony	UNI	Contaq	OPTi/UMC	OPTi	SIS	UMC
ZIF socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket
Phoenix (4/19/90)	Phoenix 3.86	AMI (12/12/91)	AMI (12/12/91)	AMI (6/6/91)	AMI (7/7/91)	AMI (7/7/91)	AMI (9/24/91)
■	□	□	□	□	□	□	□
□	■	□	■	□	□	■	■

2MB-32MB	1MB-32MB	4MB-128MB	1MB-32MB	1MB-32MB	2MB-32MB	1MB-32MB	1MB-32MB
N/A	64K-256K	64K-256K	64K-256K	64K-256K	64K-256K	32K-1MB	64K-256K
N/A	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
N/A	Write-through	Write-back	Write-back	Write-back	Write-back	Write-through	Write-back

2, 1	2, 2	3, 1	3, 1	3, 2	3, 2	3, 1	3, 0
2, 1	None	0, 1	None	None	None	0, 1	0, 1
1 2MB, 1 44MB	Dual	1 2MB, 1 44MB	1 2MB, 1 44MB	1 2MB, 1 44MB	1 2MB, 1 44MB	1 2MB, 1 44MB	Dual
170MB-528MB	105MB-400MB	80MB-2GB	40MB-1.2GB	40MB-1.2GB	40MB-2GB	130MB-500MB	80MB-1GB
Motherboard	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card	Motherboard

1, 7, 0	1, 4, 0	2, 6, 0	2, 6, 0	2, 6, 0	0, 7, 1	1, 7, 0	2, 6, 0
1, 0, 0	None	None	None	None	None	None	None
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	None	1, 2, 0	1, 2, 1	1, 2, 0
None	None	None	None	None	None	None	None

Motherboard	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card
NCR/Award	WD	WD	S3	Cirrus	S3	ATI	S3

■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
□	□	□	□	■	■	■	□

1 year	1 year	1 year on parts, 5 years on labor	2 years	1 year	1 year	2 years	2 years
\$35	Included	\$75	Included	Included	Included	Included	Included
J6VVOXY48CDT	H85DT-386AL	JKV-48650-SPR	JJK486SXNC	FHH3XG-48	SST386-40MWC	F54STD486D25DP	HOYSWAN486V1-B

► **S U M M A R Y O F F E A T U R E S**

ENDS

Products listed in alphabetical order

■ = YES □ = NO

	Telemart MITS HSY-88-486DX-50	Tenex Premier 486DX/33	Unitek UT-486DX50C	USA Flex 486DX-33MHz System	ZDS Z-425SX Model 200
List price (PC Magazine configuration)	\$1,999	\$1,999	\$1,995	\$1,995	\$1,999
Hard disk capacity	213MB	240MB	213MB	200MB	212MB
Dealers/Direct-distribution channel	■ ■	□ ■	■ □	□ ■	■ ■
Case style	Tower	Small-footprint	Tower	Small-footprint	Small-footprint
Bus architecture	ISA	ISA	EISA	ISA	ISA
Power supply (and number of connectors)	250 watts (6)	200 watts (5)	250 watts (5)	200 watts (5)	145 watts (3)
Motherboard and CPU					
Motherboard manufacturer	OPTi	DTK	Tyan	USA Flex	ZDS
Chip set manufacturer	OPTi	Symphony	OPTi	UMC	OPTi/Siemens
Processor upgrade path	Standard socket	Standard socket	Standard socket	Standard socket	Standard socket
BIOS version (or date)	AMI (6/6/92)	AMI (7/7/91)	AMI (7/7/91)	AMI (7/7/92)	ZDS 1.0
Flash memory	□	□	□	□	■
Weitek/Cyrix coprocessor socket	■	■	■	■	□
Memory and Processor RAM Cache					
Installable RAM	1MB-32MB	1MB-32MB	4MB-128MB	1MB-64MB	4MB-40MB
External RAM cache	64K-512K	64K-256K	64K-512K	64K-256K	N/A
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	N/A
Cache write design	Write-back	Write-through	Write-back	Write-back	N/A
Disk Drives					
Accessible drive bays (5.25", 3.5")	6, 0	3, 2	6, 0	3, 2	1, 2
Internal drive bays (5.25", 3.5")	2, 0	0, 2	None	0, 2	None
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB
Hard disk options	170MB-2GB	106MB-510MB	130MB-1.5GB	80MB-1.2GB	80MB-245MB
Disk controller location	ISA card	ISA card	ISA card	Motherboard	Motherboard
Expansion Bus					
8-bit, 16-bit, 32-bit slots	1, 7, 0	0, 8, 0	0, 0, 8	0, 7, 0	0, 5, 0
VESA, PCI, proprietary local-bus slots	None	None	None	None	None
Parallel, serial, mouse ports on motherboard	1, 2, 0	1, 2, 0	None	1, 2, 0	1, 1, 1
Integrated network adapter option	None	None	None	None	None
Video					
Display circuitry location	ISA card	ISA card	ISA card	ISA card	Motherboard
Video chip set manufacturer	Trident	Cirrus	Tseng	S3	WD
Software					
DOS 5.0/Microsoft Windows 3.1	■ ■	■ □	■ ■	■ ■	■ ■
Other bundled software	□	□	□	□	□
Miscellaneous					
Warranty	2 years	2 years	1 year on parts, lifetime on labor	1 year	1 year
First year on-site service charge	Included	Included	Included	Included	\$140
FCC Class B identification number	JJK486DX50C	F825K4GRAFIKA4C	KAOS7011-001-01	HZ6M48633CJMRPC	IFO-Z486SX-25R

N/A—Not applicable. The product does not have this feature.

AIIR—Advanced Integrated Research Inc., ALI—Acer Labs Inc., AMI—American Megatrends Inc., Asus—Asus Tek Computer Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elite Group Computer Systems Inc., ERI—EMPaC Research Inc., SIS—Silicon Integrated Systems Corp., SSI—Silicon Star International, TI—Texas Instruments Inc., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital.

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FastMicro Inc.

FastData 486/33+

The performance of the FastData 486/33+ will appeal to anyone who frequently uses Windows, but the \$1,999 has little else to offer.

For the same money, from a number of FastMicro's competitors you can buy better-quality components that perform much faster on DOS and some Microsoft Windows applications.

Though the components FastMicro has chosen to use are for the most part outdated, the FastData's small-footprint desktop case does leave ample room for future improvements.

FastData 486/33+**SUITABILITY TO TASK**DOS applications **GOOD**Windows applications **GOOD**Expandability **FAIR****FACT FILE****FastData 486/33+**

FastMicro Inc., 4405 E. Baseline Rd.;
Phoenix, AZ 85044; 800-821-9000;
fax, 602-431-8300

List price (tested configuration): \$1,999.

Memory and processor RAM cache: 8MB 80-ns SIMMs, 128K external cache.

Disk drives and controller: Conner CP30204 12-ms 213MB IDE hard disk with 64K cache, FastMicro MS209 ISA card disk controller, 1.2MB and 1.44MB drives.

Display: Western Digital Cardex ISA-card video controller with 1MB DRAM, CTX 1461 14-inch monitor with a 70-Hz refresh rate at noninterlaced 1,024-by-768.

Software: DOS 5.0, Microsoft Windows 3.1, choice of two: Wordperfect for Windows, Quattro Pro for Windows, Paradox 4.0, PC Tools 8.0, or Graphics Works.

In short: This small-footprint desktop case is filled with average components. You might want to investigate some of the speedier sub-\$2,000 systems.



ON READER SERVICE CARD

The FastData came with a 128K SRAM cache, but a performance-boosting 256K cache is also available. The unit also provides four empty drive bays. Memory is a little limited with a 32MB ceiling for on-board memory. Many other systems provide system memory of up to 128MB.

The Western Digital Cardex ISA-card video controller with 1MB of DRAM is based on the WD90C31 chip set; the system has a 14-inch CTX monitor. Though the chip set can handle 1,024-by-768 resolution at a VESA-compatible 70-Hz vertical refresh rate, the CTX monitor's large dot pitch and washed out colors don't make it a top choice.

The FastData 486/33+ system's best score was its Disk Winmark score, where the system just missed reaching the top-ten level; its laudable performance is due to the 128K cache built into the Conner 213MB hard disk and the FastMicro ISA-card hard disk controller.

For the most part, though, the unit's components were not outstanding. Only one of the system's scores fell below average, however: its DOS memory score.

The FastData comes with a one-year parts-and-labor warranty, which includes free on-site service from General Electric.—*OR*

Gateway 2000

Gateway 2000 4DX-33

At \$1,995, Gateway 2000's 4DX/33 provides an impressive combination of price and performance. The system's only drawback is one that is shared by all the low-cost slimline entries: You may have difficulty upgrading the system.

This competitively configured system includes a 14-inch CrystalScan monitor, Central Point PC Tools, QAPLUS diagnostic software, and the expected DOS 5.0 and Windows 3.1 software. The system's growth potential is limited, however. The slimline's three drive bays arrived from the factory filled, leaving few options for expansion. A small-footprint desktop case might have been a better choice: It would have provided more drive bays and have allowed for a moth-

**FACT FILE****Gateway 2000 4DX-33**

Gateway 2000 Inc., 610 Gateway Drive N.,
Sioux City, SD 57049; 800-523-2000, 605-
232-2000; fax, 605-232-2023

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 70-ns SIMMs

Disk drives and controller: Western Digital Caviar 2200 13-ms 200MB IDE hard disk with 64K cache, integrated disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Integrated video controller with 1MB of DRAM, Gateway 2000 Color CrystalScan 1024 NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, Central Point PC Tools, QAPLUS diagnostic software.

In short: This PC is great for users whose computing needs aren't expected to grow any time soon



ON READER SERVICE CARD

erboard with a standard ISA expansion-slot arrangement.

Gateway attempted to minimize the drawbacks of mounting the expansion slots on a perpendicular backplane (typical in a slimline case) by placing the usual three slots on the left side and an extra two 16-bit slots on the right. To use the two bonus slots, you'll have to reroute or trim most of the drive and power cables.

Benchmark test results showed no major difficulties. The Intel 486DX/33 turned in a slightly below-average processor score, but all other components managed above-average numbers. The Western Digital Caviar 200MB IDE hard disk with a 64K cache and its integrated cacheless disk controller combined to log top-ten scores on the DOS disk test and on Disk Winmark.

The integrated video system logged strong scores on the DOS video and

Gateway 2000 4DX-33

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair Service	ABOVE AVERAGE
Tech Support	ABOVE AVERAGE

With the one year's worth of free on-site service as well as parts-and-labor coverage, Gateway 2000's 4DX/33 will appeal to users who don't expect to alter their list of applications anytime soon.—OR

Gecco Computers.

Gecco 4DX-33

Gecco Computers is not well-known nationally, but what the young company, founded in 1987, lacks in visibility, it's trying to make up for with easy-to-recognize quality.

With the \$1,995 Gecco 4DX-33, the company has combined solid components with an exceptional warranty policy to become a strong entry in the low-cost computer arena.

The high points of the Gecco 4DX-33's system hardware include a Western Digital Caviar 2200 200MB hard disk with a 64K cache, an ATI Graphics Ultra video card, and an excellent, though little-known, monitor manufactured by Kou FC (Kou Feng Co.).

The system arrived in an expandable desktop case containing a 486DX/33 processor. The computer came with a 64K secondary-SRAM cache on-board, which is a little too small if you aspire to move to a DX2/66 CPU; the cache is not easily upgradable.

The placement of the SIMM banks on the motherboard is another shortcoming. Though the SIMM banks can accept up to 32MB on-board, they intrude on the expansion-card area, limiting two of the slots to 8-bit expansion cards—even though an empty area near the left side of the board could have accommodated the SIMMs. Another ex-

Graphics Winmark tests. The Gateway 2000 CrystalScan 14-inch monitor supports noninterlaced resolutions of up to 1,024 by 768.

With the one year's worth of free on-site service as well as parts-and-labor coverage, Gateway 2000's 4DX/33 will appeal to



FACT FILE

Gecco 4DX-33

Gecco Computers, 1325 W. 21st St., Tempe, AZ 85282; 800-486-1000, 602-967-7500; fax, 602-967-3610

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 60-ns SIMMs, 64K external cache

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, Kouwell KW-556F ISA-card disk controller, 1.2MB and 1.44MB floppy disk drives

Display: ATI Graphics Ultra ISA-card video controller with 1MB DRAM, KFC CM-1413 14-inch monitor with a 70-Hz refresh rate at a noninterlaced 1,024 by 768

Software: DOS 5.0, Microsoft Windows 3.1

In short: Although its motherboard was not well designed, the Gecco 4DX-33 features high-quality components and an excellent price and warranty policy. It's certainly a unit worth investigating.

ON READER SERVICE CARD

pansion slot is limited to half-length cards because of its proximity to an internal 3.5-inch drive bay.

The Gecco 4DX-33's performance on PC Labs' tests was more than acceptable.

The high point of the unit's performance was an almost-top-ten score in the processor test. The unit nearly reached the top third of the pack in the DOS disk and DOS memory benchmark tests.

The result of the DOS video test fell toward the bottom of the review group while the Gecco 4DX-33's Graphics Winmark score came in near the middle of the pack.

Gecco's warranty policy is as solid as the machine's performance. The company offers a two-year parts-and-labor warranty with free on-site service for the full two years.—OR

Gecco 4DX-33

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

Hewitt Rand Corp.

HR 486SX-25C

The \$1,998 Hewitt Rand HR 486 SX-25C is hampered by an awkward internal design that limits expandability, and its performance on PC Labs' tests failed to pull the system above the lower end of the pack.

The Hewitt Rand's mini-tower case is extremely crowded, partially because the company decided to utilize a full-size ISA motherboard. This board has seven 16-bit expansion slots and one proprietary 32-bit slot. Using this slot might be a little difficult, however, since it is obscured by the drive bay cage, which would block the insertion of any full-size expansion card.

Fortunately, Hewitt Rand's proprietary 32MB memory board is a half-length



FACT FILE

HR 486SX-25C

Hewitt Rand Corp., 8661 154th Ave. NE, Redmond, WA 98052; 800-869-7074, 206-869-5555; fax, 206-869-5151

List price (tested configuration): \$1,998

Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K external cache

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, CT Continental CCAT400G ISA-card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Trident TVGA ISA-card video controller with 1MB DRAM, Hewitt Rand HR-SV-14 14-inch monitor with a 60-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0 (\$39 option), Microsoft Windows 3.1 (\$49 option)

In short: This is a middle-of-the-road PC with a messy internal design and low benchmark test scores

ON READER SERVICE CARD

card. To use this card, however, you would have to sacrifice the use of the lowest drive bay, because the hard disk controller cable and device connectors partly cover the slot.

► HR 486SX-25C

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	GOOD

On our benchmark tests, the Hewlett Rand HR 486SX-25C was able to turn in an average performance on the DOS memory test, but the computer fell close to the bottom of the pack on the DOS processor test.

The Western Digital Caviar 2200 hard disk performed well on the Disk Winmark test, thanks to the CT Continental CCAT400G ISA-card disk controller.

Meanwhile, the system's video performance was well below average on both our DOS-based video test and the Graphics Winmark test. Its Windows graphics test rating was third from the bottom among all of the machines in this review group. The unit's overall DOS score, DOSmark, was average.

Hewlett Rand offers a one-year labor warranty and a very generous seven-year warranty on parts, which sets it apart from most of the other vendors in this group.

Hewlett Rand pays shipping both ways. On-site service is also available for an extra charge.—WPF.

Hewlett-Packard Co.

HP Vectra 486/25N

The \$2,138 HP Vectra 486/25N from Hewlett-Packard has a solid design and a high level of motherboard integration, but that may not be enough to offset the system's generally slow performance.

Price may be a factor, though: With an expected 15 percent discount, this system will sell to consumers for about \$1,820.

Inside the slimline case, the CPU and the system memory are easy to access and upgrade. Memory is expandable to 48MB using 16MB SIMMs—more than you'll ever need on this system.

All three of the 16-bit slots (all open) and the IDE hard disk controller plug into an extension on the side of the

motherboard. An example of HP's fine design sense is that the fan is tilted to blow hot air away from the CPU. Unfortunately, there was no room for storage expansion in the PC we received for testing: All the drive bays were full. An HP mouse came with the PC.

Despite the well-crafted engineering, the HP Vectra's performance on PC Labs' benchmark tests was below average. The processor test placed the HP Vectra among the bottom ten among the 62 machines we tested in this roundup.

The memory scores were also quite low, which may be explained by the HP Vectra's lack of any external RAM cache. Its DOS disk score was low, while its Disk Winmark score barely made it

HP Vectra 486/25N

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair Service	AVERAGE
Tech Support	ABOVE AVERAGE

to the middle range.

As we expected, the S3 chip set integrated on the motherboard combined with only 512K of video memory (expandable to 1MB) caused a below-average performance on the video test but fared much better on the Graphics Winmark test.

The system's motherboard exemplifies Hewlett-Packard's excellent design capabilities. The company's choice of components, however, prevented the Vectra 486/25N from placing better than in the bottom tier of the machines tested for this review.—WPF

HiQuality Systems Inc.

HiQ Ultimate 433I

A fast 486DX/33 processor combined with a host of quality components drove the HiQ Ultimate 433I to score well across a range of PC Magazine Labs' performance tests, making the unit unusually versatile for the price.

The Ultimate stands about in the middle of the 486DX/33-equipped batch in terms of the DOS processor test, but placed fairly high when compared to the entire test group.

The processor sits on a well-designed, clean motherboard.

The tower case contains eight 16-bit slots and one VESA local-bus extension and all of them are easily accessible. There are also four external 5.25-inch drive bays and a math coprocessor slot on the motherboard. A HiQ mouse was included.

The Ultimate's interior provides ample room for expansion, with all components easily accessible. There's a fan in the front to improve cooling and a clip holding the drives in place, which makes removing them a task manageable for the average user. There's also plenty room inside for full-length expansion boards.

The Ultimate notched a top-ten position in its DOS disk rating, thanks to the



► FACT FILE

HP Vectra 486/25N

Hewlett-Packard Co., 3000 Hanover St.,
Palo Alto, CA 94304; 800-752-0900

List price (tested configuration): \$2,138
Memory and processor RAM cache: 4MB 70-ns SIMMs
Disk drives and controller: Quantum LPS170 16-ms 170MB IDE hard disk with 256K cache, integrated disk controller, 1.44MB floppy disk drive
Display: Integrated video controller with 512K VRAM, Hewlett-Packard HP D1194A 14-inch monitor with a 60-Hz refresh rate at an 800-by-600 noninterlaced resolution
Software: DOS 5.0, Microsoft Windows 3.1
In short: In spite of the fact that the HP Vectra 486/25N features a solid design and a highly integrated motherboard construction, its overall performance was hurt by the manufacturer's selection of less-than-stellar components

ON READER SERVICE CARD

HiQ Ultimate 433I

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD



FACT FILE

HiQ Ultimate 433I

HiQuality Systems Inc., 740 N. Mary Ave.,
Sunnyvale, CA 94086; 800-827-5836,
408-245-5836; fax, 408-245-3108

List price (tested configuration): \$1,799.

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 256K external cache.

Disk drives and controller: Conner CP30204 12-ms
213MB IDE hard disk with 256K cache, Kouwell KW-
556G ISA card disk controller with 512K cache, 1.2MB
and 1 44MB floppy disk drives.

Display: Diamond SpeedSTAR 24 ISA card video con-
troller with 1MB DRAM, Impression 1408SV 14-inch
monitor with a 62-Hz refresh rate at 800-by-600 nonin-
terlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The Ultimate 433I is a versatile machine with
solid components for DOS users, but Windows users
may find its performance a bit weak

ON READER SERVICE CARD

Conner CP-30204 213MB hard disk with
a 32K buffer and a Kouwell hard disk
controller with a 512K cache.

The DOS video test score was almost
as impressive, due to the SpeedSTAR
ISA video card and Tseng ET4000 video
chip set, but the lackluster Impression 14-
inch monitor with its lowly 62-Hz refresh
rate and hard-to-reach controls dimmed
the advantages of the video card. The
Tseng chip set's Graphics Winmark score
was not high, and it fell within the
expected range.

The Ultimate garnered a top-ten
DOSmark score, making it a good choice
for non-Windows applications.

HiQ Systems provides a 30-day,
money-back guarantee, one year on
parts, and two years on labor, with the
first year free on-site. At just \$1,799 it's
not a bad choice for a low-cost ma-
chine.—AC

Hyundai Electronics America

Hyundai 433S

In October, Hyundai Electronics Amer-
ica began manufacturing PCs in America.
With the introduction of the first product
in the new line, the 433S, Hyundai is
showing its youth and inexperience.

The 433S arrived with parts that did
not fit, it was awkwardly designed, and
it scored in the midrange on the majority
of our benchmark tests. The exception to
these shortcomings—and a performance
that should encourage you to take a sec-
ond look—is the 433S's ability to run
Windows. The 433S placed first in our
Graphics Winmark benchmark test.

Except for the Graphics Winmark
score, the machine sent for review was
not impressive. The hard disk delivered



FACT FILE

Hyundai 433S

Hyundai Electronics America, 166
Baypointe Pkwy., San Jose, CA 95134; 800-
933-3445, 408-473-9200; fax, 408-283-4986

List price (tested configuration): \$1,949.

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 128K external cache

Disk drives and controller: Conner CP30174E 17-
ms 170MB IDE hard disk with 32K cache, integrated
disk controller, 1.2MB and 1 44MB floppy disk drives.

Display: STB Systems PowerGraph VL-24 VESA local-
bus-card video controller with 1MB DRAM, Hyundai
HCM 422E 14-inch monitor with a 72-Hz refresh rate
at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1

In short: Hyundai is new to the ranks of American
PC manufacturers, and its youth shows in the awkward
design of the 433S. The power of the video system
should be a big pull for Windows users, however

ON READER SERVICE CARD

by the company was too large for the slot
and had to be replaced; the video card,
likewise, was not suited to the machine
and a new one was substituted. And the
score for the 486SX/33's CPU on the pro-
cessor test (just a little bit above average)
is hardly a selling point.

The 433S also
suffers from some
design problems.
The unit's hard
disk bracket is
mounted over the
SIMM and power
supply sockets;
when you insert
the drive into the
bracket, the cab-
les for the power
supply could dis-
lodge the SIMMs.
The cabling was

not neat, and a lack of connectors makes
rearranging the floppy disk drive boot or-
der difficult. To Hyundai's credit, the
CPU sits in an upgradable ZIF (zero-
insertion-force) socket.

The 433S's video card and monitor are
its best features. The STB video card uses
an S3 86C805 chip and is fitted into a
VESA local-bus slot. The card and the
Hyundai 14-inch 1,024-by-768-resolution
monitor with a 72-Hz refresh rate, helped
the 433S turn in the top-rated Graphics
Winmark score. The DOS video score
was also quite a bit above average.

The company offers an 18-month
parts-and-labor warranty with free on-
site service for the first year.—AC

Hyundai 433S

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD

VENDOR SERVICE & RELIABILITY

Reliability	BELOW AVERAGE
Repair Service	BELOW AVERAGE
Tech Support	BELOW AVERAGE

IBM Personal Computer Co.

IBM PS/1 2155-G44

The new \$1,999 IBM PS/1 2155-G44 has
changed a little from the original version,
but it still can't be mistaken for a busi-
ness-class machine.

Based on a 486SX/20 processor, to-
day's PS/1 has a more standard look than
the original did. It comes in a separate
small-footprint case and uses standard
ISA bus architecture and a 14-inch IBM
monitor (Samsung was the OEM). The
case is made of thin sheet metal; there
are no chassis stiffeners, causing some
buckling of the metal near the rear. An-
other limitation is that the company left

COVER STORY

Low-Cost PCs

only one drive bay empty, but the PS/1's meager 95-watt power supply does serve to limit the number of extra drives you might run, anyway.

The motherboard does offer full integration of video, I/O ports, and drive controller circuitry, but none of these are cutting-edge components. The computer's video is based on a Tseng ET4000 chip set with only 512K of dedicated memory, with a maximum resolution of 800-by-600. The system has only five expansion slots (some other small-footprint designs offer eight). These are mounted on a shaky vertical T bracket.

Finally, though the PS/1's motherboard offers an alternative processor socket, the socket is meant for an 80487

► IBM PS/12155-G44

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair Service	AVERAGE
Tech Support	AVERAGE

math coprocessor, not an OverDrive upgrade. Without a secondary cache, the coprocessor wouldn't achieve its full potential, in any case.

Across all of PC Magazine Labs' benchmark tests, this system pulled in rock-bottom scores. Its processor, memory, Graphics Winmark, and Disk Winmark scores were all in the bottom ten, and three of these landed in the bottom five. The other benchmark test results were also uniformly below average.

IBM offers a one-year parts-and-labor warranty with a 30-day money-back guarantee, and a 48-hour parts-replacement service.—OR

Image Microsystems

Image 486DX-33

For \$1,995, Image Microsystems has introduced a low-cost powerhouse with excellent growth potential. Despite a few below-average benchmark test scores, the machine should draw attention as a reliable, expandable PC with plenty of brand-name components.

Housed in a spacious tower, the Image supports seven drive bays with a 230-watt power supply. Its Ampttron motherboard includes all the essentials, such as an easily accessible processor and memory locations as well as a clear upgrade path for the processor.

This last feature is a little more involved than your easy-out, easy-in OverDrive upgrade, but it's still relatively simple. The Image's crystal is replaceable, and there's an alternative processor socket for future processor upgrades. In some cases, you'll also have to set a couple of jumpers.

The external processor cache is at the maximum capacity (256K), so you won't have to worry about upgrading it—an unusual feature for a \$1,995 machine. You also get a Logitech Dexxa mouse.

The video subsystem is generally excellent: It consists of the popular Dia-



► FACT FILE

Image 486DX-33

Image Microsystems, 10700 Santa Monica Blvd., #4312, Los Angeles, CA 90025; 800-729-3400, 310-815-1000; fax, 310-815-9100

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, Image Microsystems LCS-6224U/G ISA card disk controller, 1.2MB and 1 44MB floppy disk drives.

Display: Diamond SpeedSTAR 24X ISA-card video controller with 1MB DRAM, Viewsonic 6E 14-inch monitor, 60-Hz refresh rate at 1,024-by-768 noninterlaced.

Software: DOS 5.0, Microsoft Windows 3.1

In short: With a spacious configuration, a competitive video subsystem, and a usable processor upgrade path, the Image 486DX-33 is a real contender among the products in our roundup.

ON READER SERVICE CARD



► FACT FILE

IBM PS/12155-G44

IBM Personal Computer Co., Rte 100, Somers, NY 10589; 800-772-2227; fax, 800-426-4329.

List price (tested configuration): \$1,999

Memory and processor RAM cache: 4MB 70-ns SIMMs

Disk drives and controller: IBM WDA-L160 18-ms 170MB IDE hard disk with 32K cache, disk controller integrated on motherboard, 1.2MB and 1 44MB floppy disk drives

Display: Integrated video controller with 512K DRAM, Samsung 33G4577 13-inch monitor with a 56-Hz refresh rate at an 800-by-600-pixel noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The PS/1 has a competitive price, but it falls short in comparison to some of the very high-performance PCs included in this roundup.

ON READER SERVICE CARD

► Image 486DX-33

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

mond SpeedSTAR 24X video controller (based on Western Digital's quick new WD90C31 chip set) and the ViewSonic 6E monitor. The somewhat distant location of the power supply and its lone fan might create cooling problems if you upgrade the system to a higher-performance CPU, however.

PC Magazine Labs' benchmark test scores for the Image 486DX-33 were generally competitive, although the machine did turn in a few erratic results. Though its video scores were excellent and its processor result good, scores on the memory test, the DOS disk test, and Disk Winmark were below average.

Image Microsystems warranty is also a little behind the times. The company offers one year for parts-and-labor with same-day replacement, but no on-site service is available. Toll-free technical support is available 24 hours a day.—OR

First SL notebook.



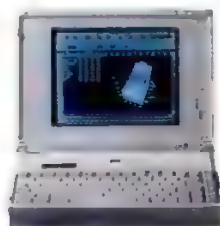
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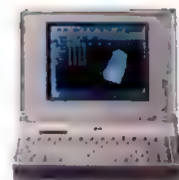
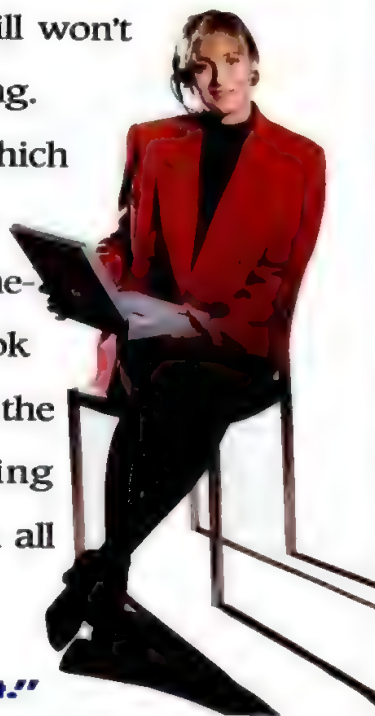
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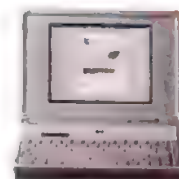
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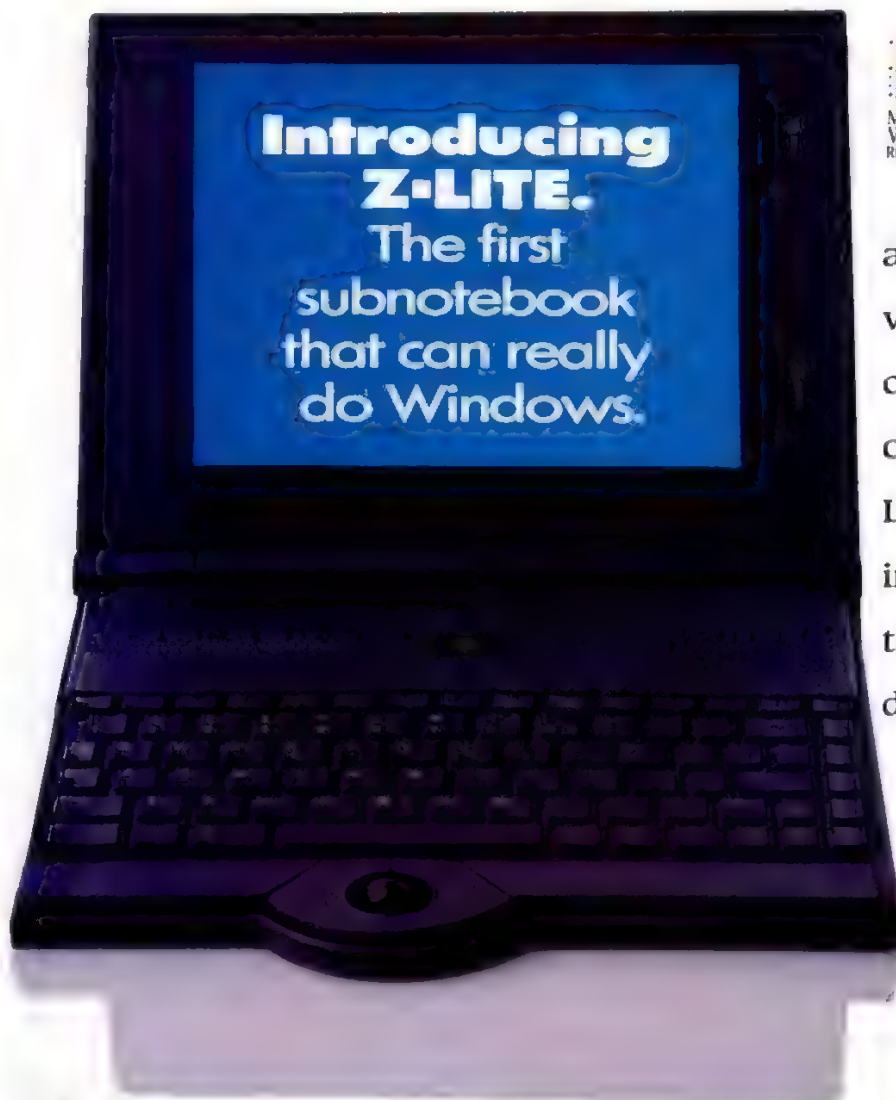
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Insight

Insight 486-33I Cache

Clean tower-case design combined with good, quality components took the \$1,999 Insight 486-33I Cache just past the middle ranks on our test routines. The unit fared particularly well in graphics performance.

The main attraction of the Insight system is the expandability of the tower; the tower configuration allows plenty of room for expansion if you're willing to add components.

The motherboard, a baby AT, is made up of both discrete-logic and very large-scale integration chips. There are six 8-bit and two 16-

bit slots, as well as plenty of room inside, making it simple to add full-length cards. The motherboard is well-secured to the tower case and won't flex under stress. It also will firmly seat expansion cards.

Insight's 486DX/33 processor placed among the top third on our processor test routines, an expected performance given the speed of the Intel chip. The Western Digital Caviar 2200 IDE hard disk with

64K cache generated similar data throughput results.

The memory, with a hefty 8MB of RAM, employs 60-nanosecond SIMM banks and generated a score that landed near the middle of the pack.

The standard ViewSonic 6E monitor (common among many of the machines we examined) combined with Diamond Computer Systems' SpeedSTAR 24X graphics accelerator produced an excellent Graphics WinMark rating that placed the unit among the top ten systems we reviewed. The unit's excellent DOS video ratings managed to land in the top third of the group. The monitor, which features a tinted, nonglare, high-contrast screen, produced an adequate image.

Insight guarantees parts and labor on the 486-33I Cache system for one year. The company does not offer on-site service, but does offer an extended warranty for an additional year, available at nine percent of the purchase price.—AC

Insight 486-33I Cache

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD



FACT FILE

Insight 486-33I Cache

Insight, 1912 W. 4th St., Tempe, AZ 85281;
800-755-9628, 602-350-1176;
fax: 602-350-1182

List price (tested configuration): \$1,999

Memory and processor RAM cache: 8MB 60-ns SIMMs, 128K external cache

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, Insight DLU 270 ISA card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond SpeedSTAR 24X ISA card video controller with 1MB DRAM, ViewSonic 6E 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, Dr. Solomon's Anti-Virus Toolkit, Stacker 2.0.

In short: This PC has an excellent video configuration for running Windows and good expansion room

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vironments. But its graphics WinMark showing, as suspected given the Tseng Labs chip, was poor. Its score on our DOS video test routines was much higher, however.

Other drawbacks cropped up. The unit shipped to us contained only one 3.5-inch floppy disk drive. One of the five 16-bit slots wouldn't accept a full-size card because the hard disk was in the way, and two others were partially blocked by the PC's fan.

At 170MB, the Conner hard disk is smaller than it is in other packages, but it is linked to an UltraStor 15C ISA hard disk controller with 1MB of cache. Windows enthusiasts should note that the

Blue Max Monolith 4250 DIUL

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD



FACT FILE

Blue Max Monolith 4250 DIUL

International Instrumentation Inc., 2282 Townsgate Rd., Westlake Village, CA 91361;
800-543-3475, 805-495-7673;
fax: 800-379-0701

List price (tested configuration): \$2,115

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Conner CP30174E 17-ms 170MB IDE hard disk with 32K cache, UltraStor 15C ISA card disk controller with 1MB cache, 1.44MB floppy disk drive.

Display: International Instrumentation Enhanced VGA proprietary local-bus video controller with 1MB DRAM, ViewSonic 6 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: None

In short: Low value in Windows environments makes this new low-end Blue Max less than a steal

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International Instrumentation Inc.

Blue Max Monolith 4250 DIUL

International Instrumentation's high-end machine passed our performance tests with flying colors last year (*PC Magazine*, Oct. 13, 1992), but the company's budget model, the \$2,115 Blue Max Monolith 4250 DIUL, failed to produce such stellar results.

The unit's main advantage is the 486DX2/50 clock-doubling processor, which drove the Blue Max to the high end of the scale in processing speed, giving it a top-ten ranking on PC Labs' benchmark tests.

The ViewSonic 6 monitor has a capable 70-Hz refresh rate and is boosted by the enhanced VGA display and the Tseng Labs ET4000AX chip in DOS en-

unit's disk scores on our Disk Winmark test were quite low, landing among the bottom five. Memory suffered because of the presence of a write-through cache policy (instead of the more efficient write-back arrangement found elsewhere), and the cache size is fairly limited at just 256K.

The mini-tower case includes two external 5.25-inch drive bays, two external 3.5-inch drives, and one internal 5.25-inch drive bay. There are also two 8-bit slots, five 16-bit slots, and one proprietary local-bus extension. A 9600/2400-bps fax modem is included.

The system has a one-year warranty, with on-site service available from International Instrumentation or TRW.—AC

Keydata International Inc.

KEY486-33 ISA

Keydata International may bundle quality software with the \$1,995 KEY486-33 ISA, but this doesn't make up for the lackluster performance of this low-cost system on most of PC Labs' test routines.

The tower case is well designed, with seven externally accessible drive bays and one internal bay, which would allow

easy expansion. The board relies heavily on very large-scale integration technology and some discrete logic. But the interior of the case has one problem:

The first three slots won't accept full-length cards because the memory modules are in the way.

Although the Keydata's CPU is upgradable, you would need to change the crystal and jumper cable settings—not advised for the amateur. A 486DX/50 will cost you another \$180, and the 486DX2/50 is an additional \$50.

The memory subsystem consists of 4MB of 70-nanosecond SIMM modules, and there's also 256K of RAM cache.

The KEY486-33 ISA's components are generally quite sound. The 256K RAM cache helped produce the system's best test results: a top-ten score on our DOS memory test routines. Its DOS processor test score for the 486/33 CPU,



FACT FILE

KEY486-33 ISA

Keydata International Inc., 111 Corporate Blvd., S. Plainfield, NJ 07080; 800-486-4800, 908-755-0350; fax: 908-756-7359

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, DFI MIO-400KF ISA card controller, 1.2MB and 1.44MB floppy disk drives

Display: ATI Graphics Ultra ISA card video controller with 1MB VRAM, ViewSonic 6E 14-inch monitor with 60-Hz refresh rate at noninterlaced 1,024-by-768

Software: DOS 5.0, Microsoft Windows 3.1, and choice of: ObjectVision, PFS WindowWorks, Quattro Pro for Windows, or Sidekick Turbo C++

In short: A bonanza of software fails to make up for this middle-of-the-road machine



ON READER SERVICE CARD

however, didn't creep out of lower end of the top third. Nor did the Maxtor 213MB hard disk do well, despite the heavy-duty DFI hard disk controller.

The powerful ATI Graphics Ultra video card supporting the standard ViewSonic 6E monitor (which has a 60-Hz refresh rate) should have run Windows with sharp clarity and speed; neither were apparent. The monitor's controls are mounted on the front toward the bottom of the screen and are easy to adjust.

For the sub-\$2,000 price, you can select one package from an array of quality software: Quattro Pro for Windows, GeoWorks, PFS:WindowWorks, Turbo C++, Borland Sidekick, or Borland Object Vision. Keydata also threw in a 9,600/2,400-bps fax modem.

Keydata offers an 18-month warranty, with free on-site service available for the first year.—AC

LodeStar Computers

LodeStar 486DLC-33

The LodeStar 486DLC-33 is a middle-of-the-road machine with a Cyrix processor/coprocessor combination. Its graphics and disk capabilities gave the unit only a slight edge over the competition, however.

Inside, the small-footprint case was quite cramped. The first slot wouldn't accept a card because the rear opening was sealed, and three of the slots didn't take large-size cards. The cache memory was difficult to reach under the drive bays. The unit comes with a Z-Nix mouse, as well as a 9,600/2,400-bps fax modem.

On PC Labs' test routines, the Cyrix Cx486DLC CPU was no showstopper, landing near the middle of the group. But



FACT FILE

LodeStar 486DLC-33

LodeStar Computer, 18539 E. Gale Ave., City of Industry, CA 91748; 800-875-7568, 818-810-3818; fax: 818-810-5928

List price (tested configuration): \$1,999

Memory and processor RAM cache: 4MB 60-ns SIMMs, 64K external cache

Disk drives and controller: Western Digital Caviar 2200 14-ms 213MB IDE hard disk with 64K cache, Promise Technology DC-99M ISA card disk controller with 512K cache, 1.2MB and 1.44MB floppy disk drives

Display: Diamond Computer Systems SpeedSTAR 24X ISA card video controller with 1MB DRAM, ADI Microscan 3E 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: The LodeStar 486DLC-33 is a Cyrix-based system that has a few advantages in running Windows



ON READER SERVICE CARD

the LodeStar does include the Cyrix Fas-Math Cx83D87 coprocessor, which would substantially speed up number crunching.

Among the unit's more attractive features is its video capability. The ADI Microscan 3E 14-inch, 1,024-by-768 noninterlaced monitor has a 70-Hz

refresh rate (slightly superior to the more common 60-Hz refresh rate available elsewhere) and is powered by a Diamond Technologies Speed-STAR 24X video

card. Together, they generate an image boasting above-average brightness, color, and contrast and produced a more-than-respectable top-ten ranking on our Graphics Winmark test routines.

Also strong were the Western Digital Caviar 2200 213MB hard disk and the SuperIDE hard disk controller with 64K cache, which resulted in a top-ten ranking on our DOS disk test routines but only average marks on our Windows disk test routines.

LodeStar supplies an unusual degree of support. It offers a two-year warranty on parts and a lifetime guarantee for on-site inspection labor. Full on-site service is free for the first year.—AC

Mega Computer Systems

Mega Impact 486SX/25+

With its \$1,550 price tag, Mega Computer Systems' Impact 486SX/25+ might be worth considering as a low-cost entry into 486-class computing—even though its processor managed a somewhat unimpressive showing on PC Labs' benchmark tests.

The Impact's standard desktop case is nicely styled and contains a fairly small motherboard. There's still room to expand, though; between the two floppy disk drives, hard disk, and power supply, there are two drive bays left open.

The unit features neither



FACT FILE

Mega Impact 486SX/25+
Mega Computer Systems, 10840 Thornmint Rd., San Diego, CA 92127; 800-338-6628, 619-487-8888; fax: 619-485-1518

List price (tested configuration): \$1,550
Memory and processor RAM cache: 4MB 60-ns SIMMs, 128K external cache
Disk drives and controller: Maxtor 7213A 15-ms 213MB IDE hard disk with 64K cache, Mega Computer Systems M9208 ISA card disk controller, 1 2MB and 1 44MB floppy disk drives
Display: BCM Enhanced VGA (LB) proprietary local-bus card video controller with 1MB DRAM, Amazing Technologies CM-8428MX 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution
Software: DOS, Microsoft Windows 3.0
In short: A rock-bottom price tag may be this modest performer's main allure

905 ON READER SERVICE CARD

integrated I/O ports nor integrated video- and drive-controller circuitry, which means that two of the six 16-bit expansion slots are occupied when shipped from the factory (one local-bus slot and one 8-bit slot are also featured). Annoyingly, you'll lose yet another slot to the extra I/O ports Mega wires from the multifunction drive-controller card through the back of the neighboring slot's rear retaining bracket. The port housing is too large to allow the use of a card with-

out a metal bracket in the slot behind it. You'll have to rewire the extra ports yourself.

The rest of the system, which comes with a Logitech Serial mouse, is comprised entirely of components presumably chosen to provide adequate performance without increasing cost. For the most part, the

Mega Impact system ranked among the bottom third of systems we reviewed. The Impact's processor ranked 44th out of 61 machines, while its memory ranked 54th. The one exception to its poor performance was its DOS video score (no doubt due to the Tseng Labs video chip set), which ranked among the top ten. Its Windows graphics rating, however, was also quite low.

Mega provides a one-year warranty on parts and labor, with no on-site service available. This is not as aggressive as warranties offered by some other competitors, but with the unit's low price and performance, Mega may not need to provide that exceptional of a warranty.—OR

Micro Express

MicroFLEX 486/DX2/50

Micro Express's \$1,995 MicroFLEX 486/DX2/50 manages an acceptable price, as well as exceptional performance. Its relatively unknown components and low-cost motherboard fared well on PC Labs' benchmark tests. The unit also comes with a better-than-average warranty.

Like many vendors here, Micro Express has filled a case with components chosen to keep the price low. Though you'll probably recognize the ATI video card and Western Digital hard disk, you may not recognize the Forex motherboard, Micro Express drive controller, and 14-inch TVM monitor. The lesser-known components may be cause for worry, since some of their manufacturers may not be around in a couple years. Even Micro Express had trouble remembering what it had sent us for testing.

On the plus side, the monitor can handle up to 1,024-by-768 resolution, and its front-mounted controls are easily accessible. Typical of low-cost systems, though, the unit comes with somewhat poor documentation; the manuals provided for the individual components were neither thorough nor well written.

If you are not troubled by the unit's

Mega Impact 486SX/25+

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	GOOD

MicroFLEX 486/DX2/50

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	FAIR



FACT FILE

MicroFLEX 486/DX2/50

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax: 714-852-1225

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K external cache

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, Micro Express DC-600B ISA card disk controller with 1MB cache, 1.2MB and 1.44MB floppy disk drives

Display: ATI Technologies Inc. Graphics Ultra ISA card video controller with 1MB DRAM, TVM Corp. MD-14 IV+ 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: With some little-known components, Micro Express has patched together a well-performing low-cost system



unfamiliar parts, you'll find that this conglomeration of components works well. In fact, the unit achieved top-ten scores on our DOS processor and memory test routines. Combined with a competitive performance on our DOS disk test routines, this showing pushed its overall DOSmark score into the top five.

However, we can't recommend it for frequent Windows users because its Windows graphics score was adequate at best. Moreover, its Windows disk score crash-landed among the bottom ten.

A smart move on Micro Express' part was offering a top-of-the-line warranty, designed to allay the fears that some may have of buying machines with unrecognizable components. The company offers a two-year parts-and-labor warranty, with on-site service available for only \$50 for the first year. Micro Express also offers 24-hour technical support.—OR

Mitsuba Corp.

Mitsuba Pro Upgradable4SX/25

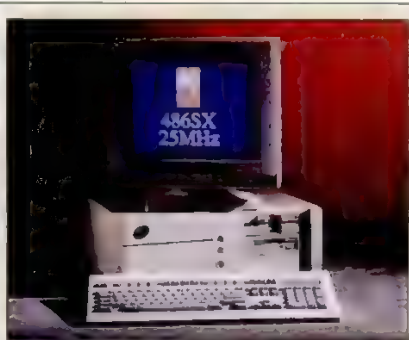
The name of this Mitsuba Corp. system—the Mitsuba Pro Upgradable4SX/25—is something of a misnomer. With a proprietary local-bus slot and a processor attached to the motherboard, the unit isn't easily upgraded.

Moreover, the Mitsuba has little to offer that can't be found on a dozen other machines. Right off the bat, the computer is stymied by the 486SX/25 microprocessor, which lagged significantly behind most of the other systems in this roundup. Upgrading would require a special tool, and related chips on the board would

Mitsuba Pro Upgradable4SX/25

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	FAIR
Expandability	FAIR



FACT FILE

Mitsuba Pro Upgradable4SX/25

Mitsuba Corp., 1925 Wright Ave., La Verne, CA 91750; 800-648-7822, 909-392-2000; fax: 909-392-2021

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 70-ns SIMMs, 128K external cache

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, Promise Technology DC-99M ISA card disk controller with 2.5MB cache, 1.2MB and 1.44MB floppy disk drives

Display: Mitsuba Enhanced VGA proprietary local-bus card video controller with 1MB DRAM, Mitsuba CM6P 14-inch monitor with a 70-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0 (Microsoft Windows 3.1 \$95)

In short: An uneven system with a fast disk drive but mixed ratings for many other components



need to be adjusted and fine-tuned.

Matters aren't much improved by the Tseng Labs ET4000AX video chip set that sits on a proprietary local-bus card. While it helped earn the unit a top-ten DOS video score, it also generated a low Windows graphics score.

Although the Mitsuba monitor has a stable 70-Hz refresh rate, the 14-inch monitor provides only 800-by-600 noninterlaced resolution, and the colors for Windows were not terribly rich on the monitor we viewed. The image would be adequate for DOS applications, however. The brightness and contrast controls are in the front,

but the vertical size, horizontal phase, and vertical center controls are mounted on the rear.

With a 213MB Maxtor 7213AT and a SuperIDE hard disk controller with 64K of cache, the unit placed third in our disk rankings. But the 128K cache contributed to very low memory access scores. System memory size is a standard 4MB of 70-nanosecond SIMMs.

Inside the small-footprint case, the small motherboard allows plenty of room around the other components. A full-length board would fit into any of the eight slots. The placement of the SIMM banks was smart because they don't interfere with the slots; all eight are left free. Adding new boards would be a snap because the motherboard permits very little flexing.

The Mitsuba comes with a one-year parts-and-labor warranty.—AC

MS Engineering Inc.

MSE 486EISA-50MHz

With its snappy DX2/50 processor, MS Engineering's MSE 486EISA-50MHz would be a wise choice if you tend to do processing-intensive work. As an added bonus, screen and video support are ideally suited to Windows.

Like several others systems also reviewed here, the MSE uses the zippy 486DX2/50 processor, making it one of the fastest machines we saw; the MSE placed sixth out of 61 machines on our processor test routines. The unit, which comes with a 400 DPI mouse, also con-

tains a two-way set associative write-back cache controller (with 128K of cache RAM) and an EISA bus, which helped give the MSE the second-highest memory-access score in this roundup.

The CTX 14-inch monitor, with 1,024-by-768 resolution, has a modest 60-Hz refresh rate. But although the MSE's Paradise graphics accelerator with the Western Digital chip set is ordinarily slow in Windows environments, the system achieved the fourth-highest Windows graphics mark in the group we reviewed. That's most likely due to the EISA bus, which allows graphics to take full advantage of the processor.

MSE 486EISA-50MHz	
SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD



FACT FILE

MSE 486EISA-50MHz

MS Engineering Inc., 10601 S. De Anza Blvd., Ste 214, Cupertino, CA 95014; 408-257-4249; fax: 408-257-4398

List price (tested configuration): \$1,995

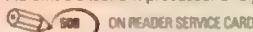
Memory and processor RAM cache: 4MB 60-ns SIMMs, 128K external cache

Disk drives and controller: Maxtor 7213A 15-ms 213MB IDE hard disk with 64K cache, MS Engineering GK-10IDE Rev 2.0 ISA card disk controller, dual 1.2MB and 1.44MB floppy disk drive.

Display: Western Digital Paradise Windows Accelerator, ISA card video controller with 1MB DRAM, CTX CVP-3468NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: An awkward component design is offset by the unit's excellent processor and graphics accelerator



Some flaws have crept into the design of the components inside the small-footprint case. The external 3.5-inch drive bays are mounted vertically above the CPU, which may have caused the instance of overheating that occurred during testing. Also, two of the five ISA slots (there are also three EISA slots) won't accept full-length cards.

The Maxtor 213MB hard disk chalked up a sluggish disk rating, and the DOS video rating was not very impressive, either. For expansion-minded users, the power supply provides 200 watts of power, enough for a number of add-on boards. Despite the imperfections, the unit has a noteworthy processor and should be more than able to live up to the demands of Windows.

MSE offers a one-year parts-and-labor warranty, but, unfortunately, on-site service is not available.—AC

National Microsystems Inc.

Flash 486DX2-50 LB

The National Microsystems \$1,995 Flash 486DX2-50 LB is an excellent Windows machine with top-notch components and performance test results that should more than satisfy most users.

The unit's most attractive features are its elegant monitor and video board. The monitor, a 14-inch Superama model, automatically scans all horizontal frequencies between 31K and 38K and all vertical frequencies between 50 Hz and 90 Hz, producing extremely crisp colors and text in both Windows and DOS environments. Its only flaw is that although it supports 800-by-600 noninterlaced resolution, it does not support the better-quality 1,024-by-768 resolution.

The system's fast Windows response is furnished by an AIR video card (containing an S3 chip) which occupies a proprietary local-bus slot. The Flash earned the seventh-highest Graphics Winmark rating in the group we reviewed. Even more impressive was the Maxtor 213MB IDE disk drive and hard disk controller from Promise Technology, which gave this unit a number five rating on our disk-speed test routines and a number ten



FACT FILE

Flash 486DX2-50 LB

National Microsystems Inc., 2979-B Pacific Dr., Norcross, GA 30071; 800-642-7649, 404-446-0520; fax: 404-449-5297

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 60-ns SIMMs, 256K external cache

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, Promise Technology DC-99M ISA card disk controller with 1MB cache, 1.2MB and 1.44MB floppy disk drives

Display: AIR AVIEW2L proprietary local-bus card videocontroller with 1MB DRAM, Superama FM360 14-inch monitor with a 90-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: A precise monitor and high-powered videocontroller make this system a good bet for running Windows. But beware of sluggish memory.



rating on our Disk Winmark test routines.

Despite the existence of a UMC cache controller, the Flash turned in rather disappointing memory scores. The unit's DOS video scores were also far from impressive—most likely due to the S3 chip.

Although it doesn't have one of the PC industry's best-known brand names, the Flash is cleanly built, and all components are accessible. The AIR motherboard makes extensive use of very large-scale integration components.

The unit comes with a 15-month warranty for parts and two years for labor, with one year of on-site service available from GE Computer Service for \$50.—AC

**Flash
486DX2-50 LB**

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD

SOFTWARE

Product	Media	Price
Spreadsheets		
□ Lotus 1-2-3 Windows 1.1 Item #58836-16	F5	\$ 315
□ Lotus 1-2-3 Windows 1.1 Item #61837-16	F3	\$ 315
□ Lotus 1-2-3 Windows 1.1 Upgrade Item #54832-16	F3	\$ 99
□ Microsoft Excel for Windows 4.0 Item #53253-16	F3	\$ 299
□ Microsoft Excel for Windows 4.0 Item #66598-16	F5	\$ 299
□ Lotus 1-2-3 2.4 Item #67606-16	F3	\$ 335
□ Lotus 1-2-3 2.4 Item #69601-16	F5	\$ 335



Lotus 1-2-3

Word Processing		
□ WordPerfect 5.2 for Windows Item #77919-19	F3	\$ 275
□ WordPerfect 5.2 for Windows Item #80915-19	F5	\$ 275
□ Microsoft Word for Windows 2.0b Item #64932-19	F3	\$ 299
□ Microsoft Word for Windows 2.0b Item #73937-19	F5	\$ 299

Word Processing Con't		
□ Lotus Ami Pro 3.0 Item #55236-19	Dual	\$ 265
□ Lotus Ami Pro 3.0 Upgrade Item #32259-19	Dual	\$ 99
Database		
□ Borland Paradox 4.0 Item #63329-08	F3	\$ 499
□ Borland Paradox 4.0 Item #63325-08	F5	\$ 499
□ Borland Paradox 4.0 Upgrade Item #89829-08	F3	\$ 189
□ Borland Paradox 4.0 Upgrade Item #91828-08	F5	\$ 189
□ DataEase Express for Windows Item #85902-11	F3	\$ 149
□ Symantec Q&A 4.0 Item #95743-13	F3	\$ 249
□ Symantec Q&A 4.0 Item #17461-13	F5	\$ 249

Presentations/Graphics		
□ Lotus Freelance Graphics for Windows Item #29190-10	F3	\$ 339
□ Lotus Freelance Graphics for Windows Item #21199-10	F5	\$ 339
□ Harvard Graphics for Windows 1.01 Item #37744-10	F3	\$ 359
□ Harvard Graphics for Windows 1.01 Item #89734-10	F5	\$ 359
□ Microsoft PowerPoint 3.0 Item #12531-03	F3	\$ 299
□ Microsoft PowerPoint 3.0 Item #82528-03	F5	\$ 299
□ Aldus Persuasion 2.1 Item #77993-03	F3	\$ 327
□ Aldus Persuasion 2.1 Item #83997-03	F5	\$ 327
□ Spinnaker PFS: Publisher for Windows Item #38927-04	F3	\$ 89

Integrated		
□ Lotus SmartSuite Item #71818-13	F3	\$ 459
□ Lotus SmartSuite Item #73818-13	F5	\$ 459
□ Microsoft Office 3.0 Item #36837-13	F3	\$ 459
□ Microsoft Office 3.0 Item #49836-13	F5	\$ 459
□ Spinnaker PFS: WindowWorks 2.0 Item #40941-13	F3	\$ 78

General		
□ Chipsoft TurboTax for Windows Headstart Item #73918-02	Dual	\$ 49
□ Chipsoft TurboTax for DOS Headstart Item #00635-02	Dual	\$ 49
□ Intuit Quicken 6.0 Item #79785-02	Dual	\$ 39
□ Intuit Quicken for Windows 2.0 Item #45870-02	Dual	\$ 29
□ Intuit Quickbooks Item #38392-02	Dual	\$ 89
□ IBM OS/2 2.0 Item #23449-17	F5	\$ 145
□ IBM OS/2 2.0 Item #26442-17	F3	\$ 145
□ Symantec Norton Desktop for Windows 2.0 Item #88164-11	F3	\$ 109

General Con't		
□ Symantec Norton Desktop for Windows 2.0 Item #63129-11	F5	\$ 109
□ Quarterdeck QEMM 386 Item #45010-17	F3	\$ 59
□ Quarterdeck QEMM 386 Item #42019-17	F5	\$ 59

PERIPHERALS AND ACCESSORIES

Multimedia		
□ Creative Labs Multimedia Upgrade Kit Item #30738-25	Int	\$ 549
□ Creative Labs Sound Blaster Pro Item #61991-54	Int	\$ 199
□ MediaVision Pro 16 Multimedia System Item #23507-54	Int	\$ 899
□ MediaVision Multimedia Upgrade Kit Plus Item #38504-54	Int	\$ 735
□ MediaVision Fusion 16 Multimedia Upgrade Kit Item #88934-25	Int	\$ 509
□ MediaVision Pro Audio Spectrum 16 Item #01507-54	Int	\$ 199



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Modems		
Cardinal Technologies 2400 w/Prodigy Kit Item #000666-41	Int	\$ 39
Practical Peripherals 2400 SA 9600Fax Item #55492-41	Ext	\$ 109
Practical Peripherals 9600 SA w/QuickLink II Item #17710-41	Ext	\$ 305
Hayes Optima 96/Smartcard EZ.32/42BIS Item #60063-41	Ext	\$ 359
Cardinal MB14400 V.32 w/Turbolox V.42 Item #40355-41	Ext	\$ 309



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Monitors

NEC Multisync 3FGX Item #55195-23	\$ 689
NEC Multisync 4FG Item #75319-23	\$ 799
Radios PrecisionColor Display 19 Item #89497-23	\$ 2,229
Dell UltraScan 14C Item #320-3364	\$ 449
Dell UltraScan 15FS Item #320-3369	\$ 549

Printers Can't

IBM/Lexmark 4019 Laser Printer Item #79641-37	\$ 875
Genicom Model 7170 Item #12844-37	\$ 3,215
Okidata OL400P LED Page Printer Item #70695-37	\$ 649
Texas Instruments Microlaser Basic Item #13399-37	\$ 899
Texas Instruments Microlaser PS17 Item #12814-37	\$ 1,215

Printers

IBM/Lexmark Personal Printer II 9Pin 80Col Item #99025-27	\$ 367
IBM/Lexmark Personal Printer II 24Pin 80Col Item #87025-27	\$ 355
Epson AP-3250 Item #330-1482	\$ 209
Canon BJ-10 Ink Jet Item #72069-28	\$ 329
IBM/Lexmark Color Jetprinter 4079 II Item #12993-28	\$ 2,749
IBM/Lexmark 4070 LJ Item #79832-28	\$ 385
Epson EPL-8000 Item #330-3347	\$ 1,159

Storage

Quantum Prodrive ELS 85MB IDE Item #03731-34	Int	\$ 225
Quantum Prodrive ELS 127MB IDE Item #09734-34	Int	\$ 295
Quantum Prodrive ELS 170MB IDE Item #16736-34	Int	\$ 335
Conner Soft-Stor 3170 Item #76828-34	Int	\$ 565
Colorado Jumbo 250 DJ-20 Item #88977-26	Int	\$ 274

Product	Media	Price
Storage Can't		
Omega Tape 250 Insider Halfheight Item #35848-34	Int	\$ 249

Networking

Artisoft LanTastic Windows Utility 4.1 Item #20664-36	Dual	\$ 179
Artisoft LanTastic Starter Kit 4.1 Item #89634-36	Dual	\$ 509
Novell Netware Lite 1.1 Item #02829-36	F5	\$ 59
Novell Netware Lite 1.1 Item #01827-36	F3	\$ 59
Windows for Workgroups Item #13151-17	F5	\$ 162
Windows for Workgroups Item #13166-17	F3	\$ 162
SMC Ethercard +Elite 16 Combo Item #23477-36	Int	\$ 198
SMC Ethercard +Elite 16T Item #11544-36	Int	\$ 145
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NCR Corp.

NCR System 3230

The \$2,000 NCR System 3230, which features a soldered-in Intel 486SX/25 processor with 4MB of RAM and a 256K RAM cache, is a study in quality and inexpensive design. But it unfortunately managed to log only average scores, at best, on most of PC Labs' tests.

The NCR System is housed in an attractive and sturdy low-profile case, yet the motherboard, which offers integrated I/O ports and integrated video- and hard disk-controller systems, was extremely clean and accessible—except for the upgrade socket, which was blocked by the Quantum 17-millisecond 240MB IDE hard disk.

Expansion options, however, are lim-



FACT FILE

NCR System 3230

NCR Corp., 1700 S. Patterson Blvd.,
Dayton, OH 45479;
800-225-5627.

List price (tested configuration): \$2,000

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 256K external cache

Disk drives and controller: Quantum LPS240AT 17-
ms 240MB IDE hard disk with 256K cache, integrated
disk controller, 1.2MB and 1.44MB floppy disk
drives

Display: Video controller with 1MB DRAM integrated
on motherboard, NCR 3298-0271 15-inch monitor with
a 70-Hz refresh rate at 1,024-by-768 noninterlaced
resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: A fine, well-crafted system that only
managed to turn in average benchmark test
scores

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NCR System 3230

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **BELOW
AVERAGE**

Repair Service **AVERAGE**

Tech Support **BELOW
AVERAGE**

ited, since the system offers only one open internal 5.25-inch drive bay. Three vertically mounted vacant 16-bit ISA slots were available, and the SIMM banks were very accessible.

The unit's 15-inch NCR monitor was designed with convenient

front-panel controls, and the display offered good colors and sharp and steady images in Windows even at its maximum 1,024-by-768 resolution at a 70-Hz refresh rate.

Also bundled with the NCR System were a two-button Microsoft serial mouse and well-illustrated documentation.

On PC Labs' benchmark tests, the integrated video system with a Cirrus Logic chip set and 1MB of video memory performed no better than the middle of the pack on our DOS video and Windows graphics tests.

The NCR System's DOS disk and overall DOSmark scores fell closer to the bottom of the pack, while its DOS processor and DOS memory marks were average. The unit's Windows disk score was slightly above average.

NCR Corp., a division of AT&T, offers a two-year parts-and-labor warranty, with free on-site service available for the first year.—RA

NEC Technologies Inc.

NEC Ready 425 System

Designed with extreme ease of use in mind, the \$1,998 NEC Ready 425 System truly lives up to its name. But lack of an external processor cache caused it to perform weakly on our benchmark tests.

This slimline had a few oddities as well as some common-sense touches. Putting the mouse and keyboard connectors on the unit's front works well for desktop users but may frustrate those who like to keep their keyboards in drawers or place their system units beneath their desks.

Inside, the Ready 425 was brilliantly



FACT FILE

NEC Ready 425 System

NEC Technologies Inc., 1414 Massachusetts
Ave., Boxborough, MA 01719; 508-264-
8000, 800-388-8888; fax: 508-264-8673

List price (tested configuration): \$1,998

Memory and processor RAM cache: 4MB 80-ns
SIMMs

Disk drives and controller: Conner CP30174E 17-
ms 170MB IDE hard disk with 32K cache, integrated
disk controller 1.2MB and 1 44MB floppy disk drives.

Display: Integrated video controller with 1MB DRAM,
NEC Ready 1024 14-inch monitor with a 60-Hz refresh
rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, NEC
Desktop by Peter Norton, PFS:WindowWorks, Prodigy,
Quicken, and WinFax PRO

In short: Though easy to use and cleverly engineered,
the unit's performance doesn't compete with com-
parably priced systems.

511 ON READER SERVICE CARD

laid out, giving clear access to all areas of the motherboard—including its Over-Drive socket, SIMM banks, and three vertically mounted 16-bit ISA slots. Besides having integrated I/O ports and integrated video- and drive-controller

systems, the motherboard held a 9,600/2,400-bps fax modem. As you may expect, however, the unit's slimline case leaves no room for expansion. The external 5.25-inch bay and the internal and external 3.5-inch bays hold the floppy disk drives and the 170MB

NEC Ready 425 System

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Expandability **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE
AVERAGE**

Repair Service **AVERAGE**

Tech Support **AVERAGE**

Conner hard disk.

The NEC Ready monitor produced sharp, clear images in Windows, and NEC's Perfect Touch keyboard, with its excellent key travel, was a pleasure to work with.

The integrated video system, with a maximum resolution of 1,024-by-768 and a Cirrus Logic chip set, generated average Windows graphics and DOS video test scores. Unfortunately, that's as high as the unit's marks went. Its DOS processor and Windows disk scores fell near the very bottom of the test group, while its overall DOSmark, DOS memory, and DOS disk scores were below average.

NEC Technologies offers a one-year warranty on parts and labor and free on-site service for the first year. NEC also provides remote diagnostics service via its ReadyRemote system.—RA

NETiS Technology Inc.

NETiS Ultra WinStation N433L

At \$1,790, the Intel 486DX/33-based NETiS Ultra WinStation N433L, which came with 4MB of RAM and a 256K external processor cache, produced some of the best DOS-based scores in this review, ranking number three and number two, respectively, in DOS disk and DOS video performance.

The Ultra WinStation's Maxtor 15-millisecond 213MB IDE hard disk with a 64K cache and the Promise Technology DC99 controller with a 2MB cache combined to produce one of the test group's best DOS disk scores. The combination also pushed up the unit's overall DOS mark score and helped produce an above-average Windows disk mark.

The integrated NETiS proprietary local-bus video system with a Tseng ET4000AX chip set secured a top-level DOS video score but generated only an average mark on our Graphics Winmark test.

The Ultra WinStation came in a small-footprint desktop case with three external 5.25-inch drive bays, two of which



FACT FILE

NETiS Ultra WinStation N433L

NETiS Technology Inc., 1606 Centre Pointe Dr., Milpitas, CA 95035; 408-263-0368; fax: 408-263-4624

List price (tested configuration): \$1,790

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Maxtor 7213A 15-ms 213MB IDE hard disk with 64K cache, Promise Technology DC-99M ISA card disk controller with 2MB cache, 1 2MB and 1 44MB floppy disk drives

Display: NETiS N433L VGA ET4000LB proprietary local-bus card video controller with 1MB DRAM, CTX 5468A 14-inch monitor with a 60-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: Though it earned second-place disk scores and third-place DOS video scores, the unit managed only average scores elsewhere

513 ON READER SERVICE CARD

were occupied by the 1.2MB floppy disk drive, and, oddly, the 1.44MB floppy disk drive. Meanwhile, the unit's single external 3.5-inch drive bay remained empty.

The NETiS motherboard's single proprietary local-bus slot was occupied by the NETiS video adapter. Some SIMM banks were obscured by cables, as well as by the power supply, but they could be reached with effort. And the Intel processor was accessible once the video board was removed.

The Ultra WinStation N433L's keyboard is quiet, mushy, and fairly light. The CTX 14-inch monitor provides an adequately sharp image in both DOS and Windows and supports noninterlaced resolutions of up to 800-by-600 at a 60-Hz refresh rate.

NETiS Technology offers a one-year parts-and-labor warranty. On-site service is available for \$80 for the first year.—RA

Occidental Systems Inc.

Occidental 33MHz 486DX

Occidental Systems' \$1,995 33MHz 486DX provides a high level of motherboard integration and plenty of room for expansion, but it lacks a processor RAM cache and turned in mostly average-to-below-average test scores.

On the outside, the Occidental has easy-to-use switches and helpful LED (light-emitting diode) readouts and indicators. Within the small-footprint desktop unit, all seven 16-bit ISA expansion slots (including one with a 32-bit VESA extension) and the single 8-bit slot were open. Three slots (two 16-bit and the 8-bit) were cramped by the drive bays. The Intel 486DX/33 microprocessor was seated in a convenient ZIF (zero-insert-



FACT FILE

Occidental 33MHz 486DX

Occidental Systems Inc., 3771 Lexington Ave., St. Paul, MN 55126; 800-525-6543, 612-486-0020; fax: 612-486-0019

List price (tested configuration): \$1,995

Memory and processor RAM cache: 4MB 60-ns SIMMs

Disk drives and controller: Seagate ST3283A 12-ms 240MB IDE hard disk with 128K cache, disk controller integrated on motherboard, 1.2MB and 1 44MB floppy disk drives

Display: Video controller integrated on motherboard with 1MB DRAM, CTX CVP-5468NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1

In short: The unit features a well-integrated motherboard, but most of the components turned in lackluster performance

514 ON READER SERVICE CARD

COVER STORY

Low-Cost PCs

tion-force) socket, and the SIMM banks and complementary metal-oxide semiconductor battery were easily accessible.

A tangle of cables blocked portions of the Occidental's motherboard, and the

Occidental 33MHz 486DX	
SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

connectors for the integrated hard/floppy disk controller were hidden beneath the power supply. The video and I/O systems were also integrated, but no OverDrive or

math coprocessor socket was provided.

The Occidental's compact keyboard has a good, tactile feel, and the unit's 14-inch CTX monitor supports noninterlaced resolutions of up to 1,024-by-768.

With the exception of a top-level Windows disk test score (provided by a Seagate IDE 240MB hard disk and motherboard-based controller) the Occidental produced only average and below-average test scores. It finished near the bottom of its class with its DOS memory, DOS disk, and overall DOS test scores and turned in only average test scores on our DOS processor, video, and Windows graphics tests.

Occidental, a subsidiary of Zeos, offers a one-year parts-and-labor warranty. On-site service is \$35 for the first year.—RA

PC Brand Inc.

PC Brand Leader 486/DLC-33

Although it comes with a relatively slow Cyrix 486DLC 33-MHz chip, 4MB of RAM, and a 64K RAM cache on an integrated motherboard, the \$1,945 PC Brand Leader 486/DLC-33 offers a wide range of processor upgrade options. Most of its components, though, turned in benchmark test scores that barely crept above the middle range.

The Leader came in a slimline case with two external 5.25-inch bays and two external 3.5-inch bays. Only one 5.25-inch bay was occupied by a dual 1.2MB/1.44MB floppy

PC Brand Leader 486/DLC-33

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair Service	AVERAGE
Tech Support	AVERAGE



FACT FILE

PC Brand Leader 486/DLC-33

PC Brand Inc., 405 Science Dr., Moorpark, CA 93021; 800-722-7263, 805-378-7848; fax: 805-7378-7801

List price (tested configuration): \$1,945
Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K external cache.
Disk drives and controller: Seagate ST8283A 12-ms 245MB IDE hard disk with 128K cache, integrated disk controller, dual 1.2MB/1.44MB floppy disk drive.
Display: Integrated video controller with 1MB DRAM, Supercard SV1485 13-inch monitor with a 72-Hz refresh rate at 1,024-by-768 noninterlaced resolution
Software: DOS 5.0, Microsoft Windows 3.1.
In short: An easily upgradable PC with a smartly-designed interior, the PC Brand Leader 486/DLC-33 managed only fair performance on PC Labs' tests

disk drive, however, leaving room for a little expansion.

The unit's motherboard offered an unusual layout. The Cyrix processor was installed on a daughtercard inserted into a standard Intel-type CPU socket, while a Cyrix FasMath CX83587-33GP math coprocessor occupied a nearby 387/487-type socket. Also provided was a useful OverDrive upgrade socket. The unit's external RAM cache is expandable to 256K.

Hidden beneath the Seagate 245MB IDE hard disk, which was relatively easy to remove, was a maze of more than 70 configuration jumpers, which novices would be well-advised to leave alone. Integrated on the motherboard

were the drive controller, video system, and I/O ports. The PC Brand 13-inch monitor offered 1,024-by-768 noninterlaced resolution at an eye-pleasing 72-Hz refresh rate and provided clear and sharp images in Windows.

While the unit bottomed out with its Windows graphics score, due to its use of the Western Digital video chip set, it managed to earn above-average Windows and DOS disk test scores, as well as above-average scores in DOS memory, DOS video, and overall DOS performance. But the system turned in below-average DOS processor marks.

PC Brand offers a one-year parts-and-labor warranty and free on-site service for the first year.—RA

Polywell Computers Inc.

Poly 486-50i

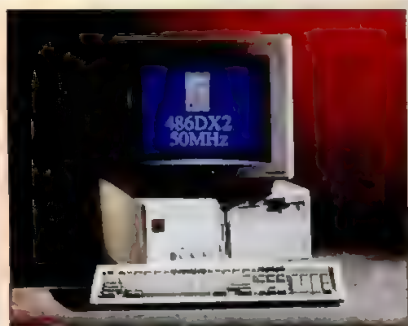
The \$1,998 Polywell Poly 486-50i provides few frills and no motherboard integration, but it logged a series of sterling scores on PC Labs' benchmark tests, largely due to the use of an Intel 486DX2/50 processor, 4MB of RAM, and a 64K external RAM cache that is expandable to 256K.

The Poly 486-50i turned in some of the test group's highest DOS processor, DOS disk, and overall DOS-mark scores. It also managed strong DOS memory, DOS video, Windows disk, and Windows graphics marks.

The unit arrived in a good-looking small-footprint desktop case that offered three external 5.25-inch drive bays (one occupied) and a single occupied external 3.5-inch drive bay. There was also a single occupied 3.5-inch internal drive bay.

Inside, the real estate was cramped, with a thick bundle of cables tucked behind the drives. Two of the six 16-bit ISA slots were occupied by a Polywell Super VGA adapter with a Western Digital chip set, and a Promise Technology hard disk controller with a 512K cache. One

Poly 486-50i	
SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair Service	AVERAGE
Tech Support	BELOW AVERAGE



FACT FILE

Polywell 486-50i

Polywell Computers Inc., 61-C Airport Blvd., San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax: 800-999-1278

List price (tested configuration): \$1,998

Memory and processor RAM cache: 4MB 60-ns SIMMs, 64K external cache.

Disk drives and controller: Maxtor 7213A 15-ms 213MB IDE hard disk with 64K cache, Promise Technology DC-99M ISA card disk controller with 512K cache, 1.2MB and 1 44MB floppy disk drives.

Display: Polywell SVGA-F ISA card video controller with 1MB DRAM, Supercard CAC14NF 13-inch Goldstar monitor with a 60-Hz refresh rate at 800-by-600 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: A gem of a machine, flawed only by a cramped case, little motherboard integration, and a less-than-sharp monitor.



ON READER SERVICE CARD

8-bit slot was filled by an I/O card.

Some SIMM banks on the Polywell motherboard were blocked by the power supply, and one 16-bit slot and the two 8-bit slots were cramped by the Maxtor 15-millisecond 200MB IDE hard disk and the floppy disk drives.

The Polywell 14-inch monitor (manufactured by Goldstar) has convenient front-panel controls but, with a maximum refresh rate of 60 Hz at 800-by-600 noninterlaced resolution, flickered noticeably. Its colors were somewhat dim, and some pincushioning was apparent. The unit came with a lightweight Chicony 101-key keyboard that had a mushy feel but was adequate.

Polywell offers a 30-day money-back policy, a one-year parts and five-year in-house labor warranty, and ten years of toll-free support. On-site service is \$75 for the first year.—RA

QSI Corp.

Klonimus 486/SX25

QSI Corp.'s \$1,976 Klonimus 486/SX25 desktop has ample room for expansion, but its design and components are unimpressive and its benchmark test scores tended to be low on most of PC Labs' tests.

Four of the five drive bays in the Klonimus are accessible from the front. The other one is tucked under the 200-watt power supply.

Setup could be complicated because the neatly laid-out QSI motherboard has a relatively large number of jumpers. Also, the system's two 8-bit expansion slots can only accept half-length cards be-



FACT FILE

Klonimus 486/SX25

QSI Corp., 95 Rockwell Place, Brooklyn, N.Y. 11217; 800-347-5500, 718-834-4545; fax: 718-834-5318

List price (tested configuration): \$1,976

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital WDCA2200-32F 14-ms 213MB IDE hard disk with 32K cache, Goldstar IDE Plus-V3 ISA card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond Stealth VRAM ISA card video controller with 1MB VRAM, CTX CVP-5468NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1

In short: With a jumper-filled motherboard and weak test scores, the unit didn't keep up with its competition.



ON READER SERVICE CARD

cause they are in line with the unit's 3.5-inch drive bays.

The combination of a Goldstar IDE controller without cache memory and a Western Digital 14-millisecond 212MB hard disk with an unusually small 32K buffer was the performance high point for the system. But even here, the unit certainly didn't stand out from the pack, ranking number 21 out of 61 systems.

The system's DOS video and DOS memory scores were quite low. Both scores were within the bottom five of all machines in this test group.

The unit's DOS processor score was sluggish, which wasn't surprising considering the use of the 486SX/25 processor. But among the scores of the other 486SX/25 machines—which made up about one third of this test group—the Klonimus's DOS processor score was among the best.

The Klonimus's Windows graphics test ranking was marginally better than its other scores, due to the use of the S3 chip set that comes with the Diamond Stealth VGA adapter. The 14-inch CTX monitor is adequate, but, with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution, there was noticeable flicker when running Windows applications.

Klonimus offers a two-year warranty on parts and labor, with free on-site service from TRW for the first year.—HFW

Quill Corp.

Qtech PC-4D33-4

The \$1,999 Qtech PC-4D33-4 desktop unit has a neat, well laid-out motherboard but virtually nothing else to distinguish it from the rest of the pack of low-cost computers in this roundup.

The best thing about the Qtech is the Mycomp motherboard. All of the expansion slots are unimpeded, and the drive bays, mem-

Qtech PC-4D33-4	
SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair Service	AVERAGE
Tech Support	BELOW AVERAGE

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Products listed here in red are Microsoft Windows Applications.

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5228	Corel Systems	□ CorelDRAW! 3.0 Competitive Upgrade	225
4560	ExpertVision	■ TypeReader 1.01 Competitive Upgrade	149
8403	Gold Disk	□ Gold Disk Professional Draw Comp. Upgrd. .	115
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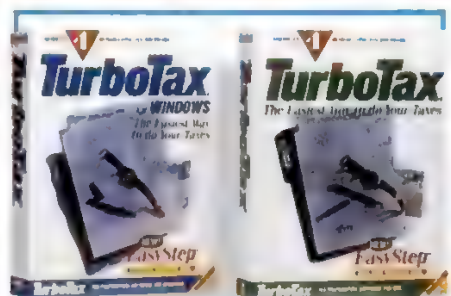
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Technology Concepts ... 2 years		
6315	Fax Line Manager 203	125.

TheComplete PC ... 2 years		
6069	TheComplete Modem Plus	\$95.
8593	TheComplete Communicator Gold	479.
Tripp Lite ... 2 years		
6199	Isobar 4-6 (4 outlets, Gold Seal Warranty)	49.
6200	Isobar 6-6 (6 outlets, Gold Seal Warranty)	59.
6807	OMNI 450 LAN Power Backup	279.
6797	OMNI 600 LAN Power Backup	369.
9312	BC500 Power Backup	219.
Video Seven ... 7 years		
7362	WIN.VGA 1 MB (1024 x 768,256 color)	129.
9261	WIN PRO 1 MB (1024 x 768,256 color)	175.
Zoom Telephonics ... 7 years		
1166	AMX 2400 Baud External Modem	63.
1307	Int. 2400 Baud w/9600 Baud Fax Modem	79.
1178	Ext. 2400 Baud w/9600 Baud Fax Modem	92.
1494	Ext. 9600V.32..... 195. 3075 Internal	195.
3574	Ext. 2400 Baud V.42/9600 Baud Fax	115.
3386	FaxModem AFC (2400 baud 96S/48R)	59.
4430	FaxModem AFX (2400 baud 96S/48R)	79.
4429	FaxModem VFP V.32bis 14,400 baud (internal)	219.
4428	FaxModem VFX V.32bis 14,400 baud (external)	259.
7921	Pocket FaxModem	87.

DRIVES

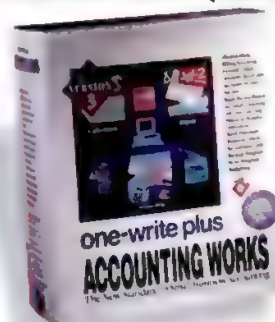
Colorado Memory Systems ... 1 year		
4194	Jumbo 120 Tape Backup	199.
4354	Jumbo 250 Tape Backup	269.
1213	Trakker 120 Tape Backup (parallel)	359.
1073	Trakker 250 Tape Backup (parallel)	429.
Conner Peripherals ... 1 year		
2339	CP30104H 120 MB IDE HD (19 ms)	299.
1337	CP3204 200 MB IDE HD (16 ms)	479.



Zoom Telephonics ... 7 years
Zoom V.32bis FaxModems feature auto fall back/fall forward and 14,400 bps fax/data. External model has 15 status lights.
4428 VFX V.32bis (external) \$259.
4429 VFP V.32bis w/16550 UART (int.) 219.

IOMEGA ... 1 year		
6499	Transportable 90 PRO	659.
6343	PC Powered 90 (incl. PC2B & cartridge)	499.
6344	PC Powered 90 PRO (incl. PC2B, cartridge & Central Point Software)	599.
2500	PC2B-2 Controller	149.
2530	90 MB Cartridge..... 149. 2467 Tripak	439.
8480	Tape250 Insider Tape Backup	239.
8481	Tape250 Inside Half-Height Tape Backup	259.
8482	Tape250 PC Powered Tape Backup	359.
10103	21 MB Floptical Drive (internal)	459.
10104	21 MB Floptical Drive (PC Powered)	499.
NEC ... 2 years		
6577	CDR37 Portable CD-ROM Drive	399.
6582	CDR74 Portable CD-ROM Drive	589.
6581	CDR84 Internal CD-ROM (reqs. interface)	569.
Pacific Rim ... 1 year		
1304	1.2 MB External (for any parallel port)	239.
2761	1.44EX MB Ext. (for any parallel port)	239.
Peripheral Land, Inc. ... 1 year		
8736	Infinity Floptical Drive	399.
8735	Infinity 88 MB Removable (Syquest)	699.
Quantum ... 2 years		
8304	Plus Hardcard II XL 50 MB (9 ms)	225.
8287	Plus Hardcard II XL 105 MB (9 ms)	325.
4735	Hardcard E7 127 MB IDE (17 ms)	349.
4714	Hardcard E7 240 MB IDE (16 ms)	569.
TEAC ... 1 year		
6951	1.2 MB Drive for AT	65.
4670	1.44 MB Drive for PC/XT (3 1/2")	59.
4326	1.44 MB Drive for AT (3 1/2", with Bastech)	75.
4414	3 1/2" 5 1/4" Dual Floppy Drive	145.

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5510	1 MB x 9 SIMMs (80 nanosecond)	call
2497	4 MB x 9 SIMMs (80 nanosecond)	call
5746	1 MB Chips (80 ns, set of 9)	call

DISKS/MEDIA

Fuji ... lifetime		
2214	3 1/2" DS Disks (10)..... 9.	2242 (50)..... 32.
2215	3 1/2" HD Disks (10)..... 15.	2241 (50)..... 59.
4863	3 1/2" HD Disks (20) w/storage case	26.
Sony ... lifetime		
3292	5 1/4" HD Disks (Qty. 10)	11.
3297	3 1/2" DS Disks (10)..... 9.	6148 (30)..... 25.
3298	3 1/2" HD Disks (10)..... 15.	6375 (30)..... 42.
8185	QD2040..... 14.	1895 QD2120..... 21.
3M ... lifetime		
3943	DC2000..... 17.	1581 DC2120..... 22.
Toshiba ... 2 years		
4858	3 1/2" 2.88 MB ED Disks (Qty. 5)	28.
9755	3 1/2" 2.88 MB ED Disks (Qty. 10)	53.

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COVER STORY

Low-Cost PCs

ory modules, and processor are fairly easy to reach. On the downside, the RAM cache, located beneath the drive bays, is inaccessible.

The front switches are protected by a door, which prevents them from being accidentally pushed. Unfortunately, the power switch is difficult to reach on the back of the unit. But Quill claims to be moving the power switch to the front of the case as of December 1 of last year.

The Boca Research SVGA card and Cirrus Logic video chip set achieved the best ratings among the Qtech's components, but even so, its DOS video score barely crawled into the top third. The Windows graphics test results were below average. To make matters worse, the screen on the Tatung monitor required constant readjustment, and there was noticeable flickering under Windows.



FACT FILE

Qtech PC-4D33-4

Quill Corp., 100 Shelter Rd. Lincolnshire, IL 60069; 708-634-6650; fax: 708-634-6766

List price (tested configuration): \$1,999

Memory and processor RAM cache: 4MB 70-ns SIMMs, 128K external cache

Disk drives and controller: Maxtor 7213A 15-ms 213MB IDE hard disk with 64K cache, TMC IFSP-1 50 ISA card disk controller, 1.2MB and 1 44MB floppy disk drives

Display: Boca Research SVGA-2 ISA card video controller with 1MB DRAM, Tatung CM14UAE 14-inch monitor with a 61-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, Quattro Pro for DOS 4.0, or Quattro Pro for Windows 1.0

In short: Apart from its elegant interior, the unit falls in line with a host of other budget-minded midrange systems we encountered

 ON READER SERVICE CARD

The 486DX/33 processor placed among the bottom third of 486DX/33s we tested (a group that made up 35 percent of the machines in this roundup) but near the middle of all processors tested. Its ranking could be improved by upgrading the RAM cache from 128K to 256K, which would cost \$50 extra. This would push the price past \$2,000, but the performance improvement would likely make the expense worthwhile. Memory performance might also improve with the added cache.

The system's Maxtor 213MB IDE hard disk with a 64K cache and its TMC ISA-card disk controller came in well below average on both our DOS and Windows disk test routines.

Quill Corp. offers a one-year warranty on parts and labor and free on-site service from Memorex Telex.—HFW

Sirius Systems Technology Inc.

SST 386-40 MWC

The \$1,850 SST 386-40 MWC desktop enters the arena with a crippling disadvantage: Its AMD 386DX/40 CPU is one of the slowest processors in the group. Performance is also hindered by its components, most of which turned in test scores in the middle of our ratings.

For \$175, you may want to upgrade the SST to the faster 486 DLC/33, which would push the system's cost over our \$2,000 limit by \$25. That change by itself won't overcome the system's other shortcomings, however.

The SST, which comes with a Z-Nix mouse, has standard expansion characteristics. There are five drive bays, all of which open to the front. One of its eight expansion slots can be dedicated to memory but will take other types of cards. Two of its seven remaining 16-bit slots are occupied by the IDE controller and video card. This leaves five slots available for other peripherals.

The machine did well on our DOS memory test routines, placing in the top 30 percent. The rest of the SST's performance scores hovered around average, with its Windows graphics score being



FACT FILE

SST 386-40 MWC

Sirius Systems Technology Inc., 4344 Young St., Pasadena, TX 77504; 800-424-0724, 713-946-0724; fax: 713-946-5451

List price (tested configuration): \$1,850

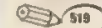
Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache

Disk drives and controller: WD Caviar 2200 14-ms 212MB IDE hard disk with 64K cache, IFSP 1.50 ISA disk controller, 1.2MB and 1 44MB floppy disk drives

Display: STB Wind/X ISA card video controller with 1MB VRAM, CTX CMS-1461 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768 noninterlaced resolution

Software: DOS 5.0, Microsoft Windows 3.1, Cache86 4.13, PreCursor 4.0, Tree86 3.21

In short: The system is hobbled by a slow processor, the remainder of its components are adequate at best

 ON READER SERVICE CARD

slightly above average.

The unit's DOS video score neared the bottom of the group. The STB video card carries the S3 chip set, optimizing it for Windows use. But the use of the S3 chip set and the 1MB of 80-nano-second video memory also helps explain the unit's low DOS score.

The system comes with a fairly good CTX 14-inch monitor that is flicker-free in Windows and has a 72-Hz refresh rate at a noninterlaced resolution of 1,024-by-768. It tended to produce slightly distorted images, however.

Sirius Systems Technology offers a one-year warranty on parts and labor and free on-site service from Idea Serv-Com, as well as toll-free technical support.—HFW

SST 386-40 MWC

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **GOOD**

VENDOR SERVICE & RELIABILITY

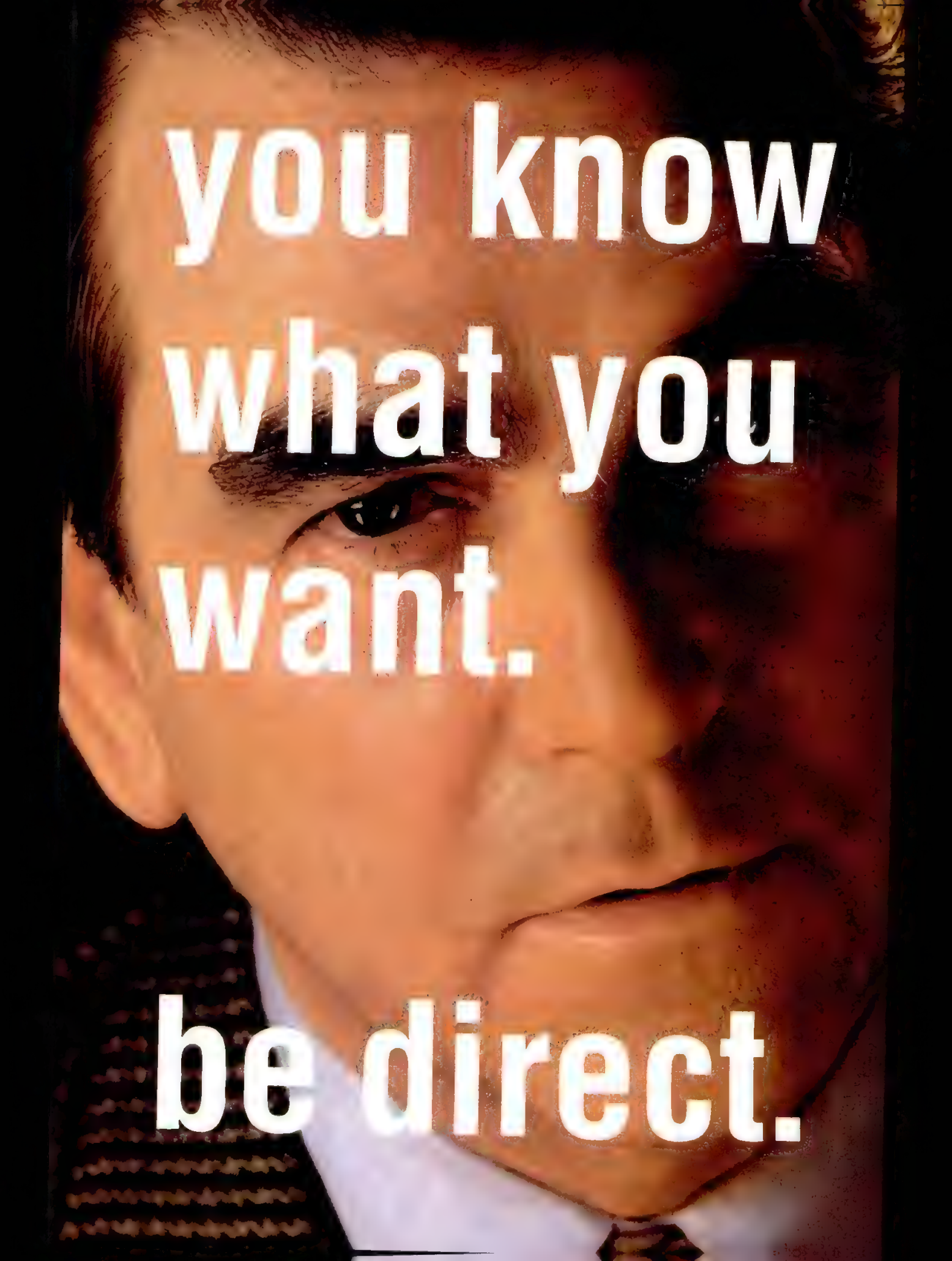
Reliability **ABOVE AVERAGE**

Repair Service **AVERAGE**

Tech Support **BELOW AVERAGE**



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a low price.
and high praise."**



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— PC Week, October 5, 1992

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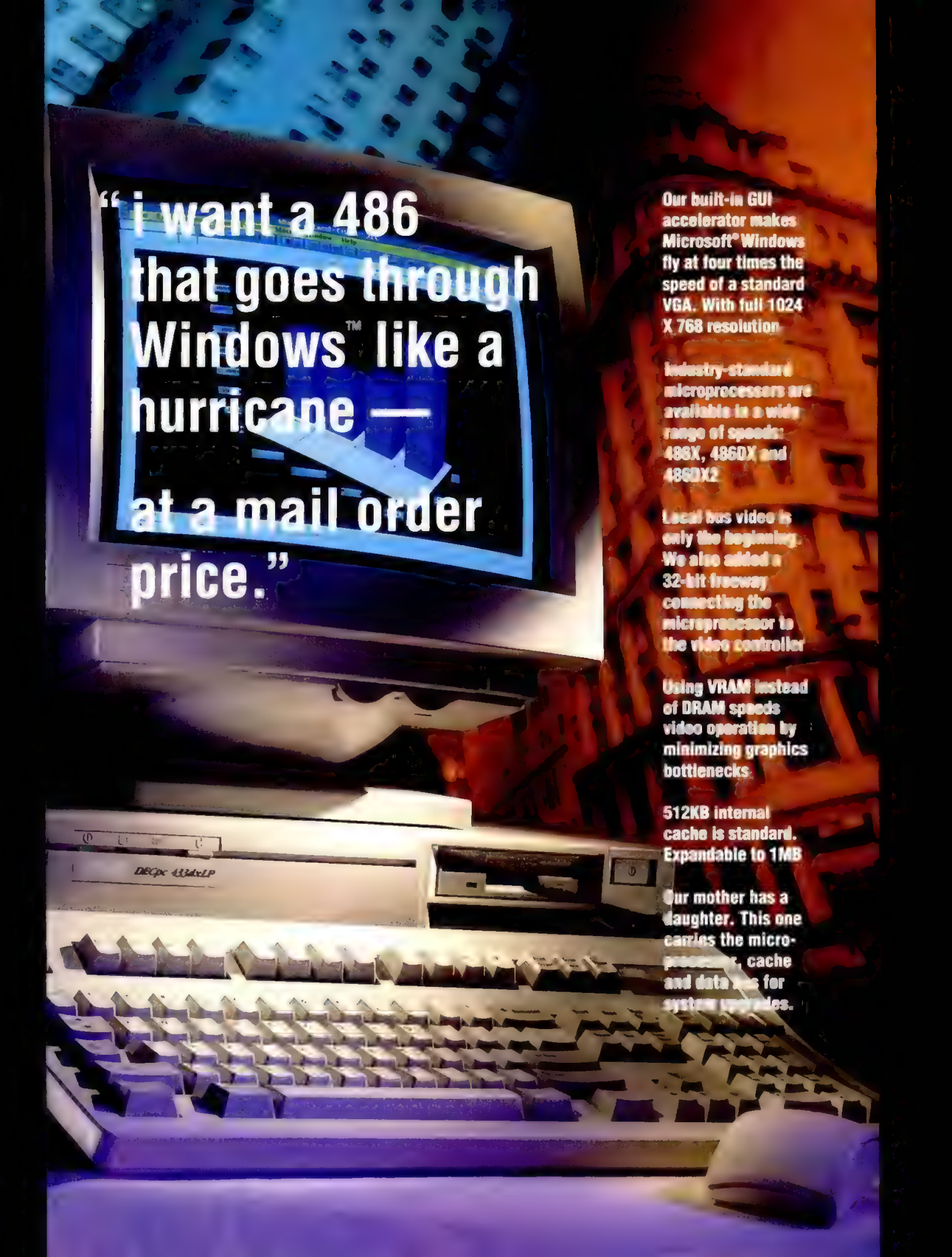
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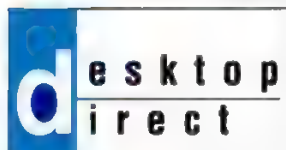
— PC Computing, January, 1993

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Benchmark Tests: The DECpc 450d2 LP

We tested the clock-doubled 50-MHz DECpc 450d2 LP, one of six machines in Digital's new DECpc LP series, and found that its implementation of local-bus video yields outstanding results on our Graphics Winmark benchmark test.

We used PC Magazine Labs' Hardware Performance Tests, Release 6.0, to measure each PC's performance. The Graphics Winmark is the geometric mean of 12 Windows-based graphics tests from WINBENCH 2.5, weighted to reflect how frequently various functions are used.

Higher scores represent better performance.	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)	Graphics Winmark (megapixels per second)
DECpc 450d2 LP (486DX2/50)	506	5,406	193	2,182	12.98
50-MHz 486DX2 average	487	6,430	276	2,539	5.51
Dell System 486D/50 (486DX2/50)	450	5,525	241	4,272	1.58



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November 24, 1992

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Pick your brain. 486SX, 486DX, and 486DX2 industry-standard microprocessors are available in a wide range of speeds

The Vacancy Socket is the quick and easy way to upgrade your DECpc. Just add the appropriate Intel OverDrive chip

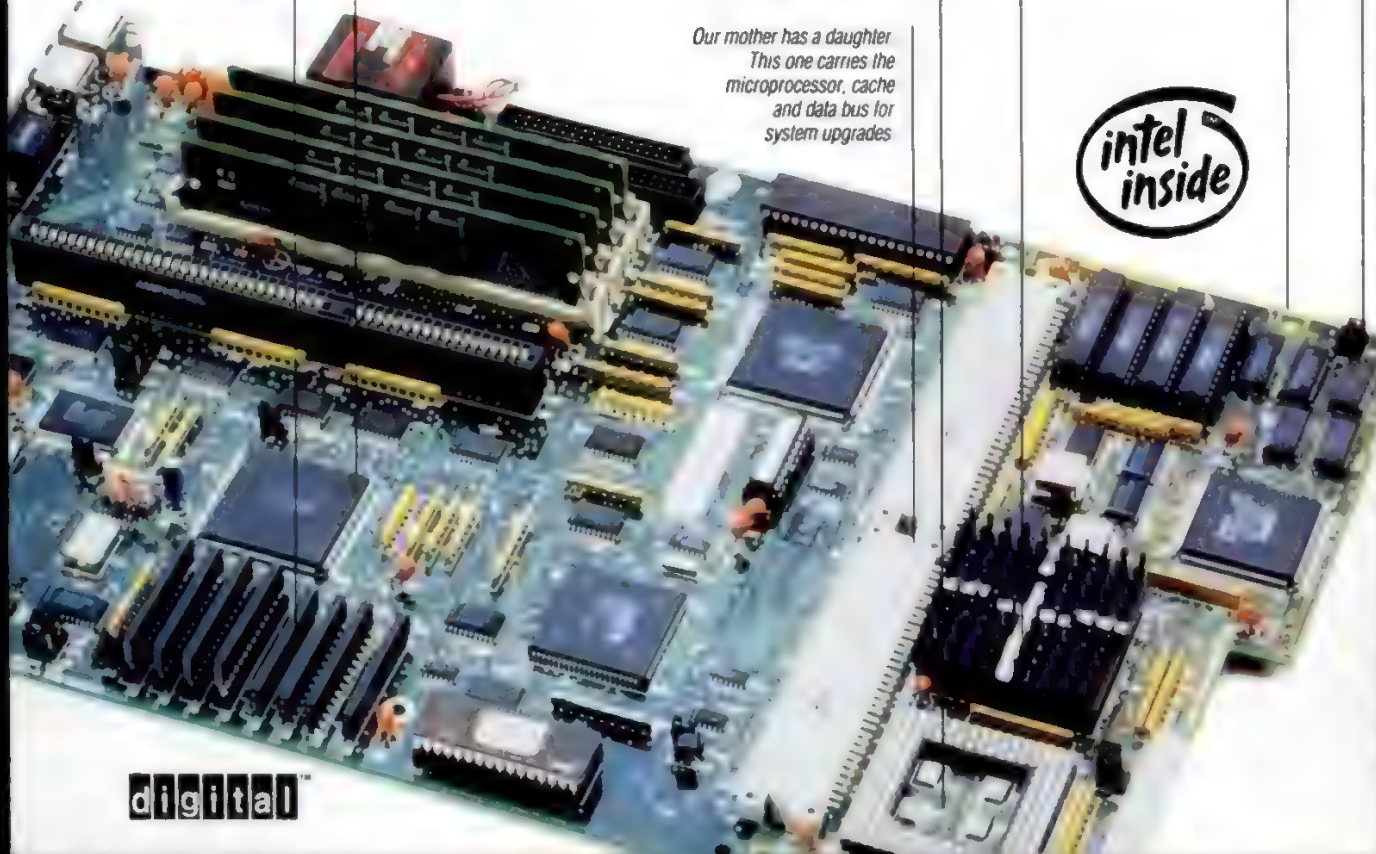
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“Who'd have imagined a year ago that you could get as much performance and as crafty a design as you'll find in the DECpc for under \$2,500?”

— PC Computing, January, 1993

Scoreboard

Based on a scale of
1-5 (5=excellent)

		Advanced Logic Research Inc Flyer 32DT 40X/33	AST Research Inc Bravo 4/33 Model 123B	Dell Computer Corp Dimension 486DX/33	Digital Equipment Corp DECpc 433dx LP	IBM PC Co. PS/1 Model 2155-S76	Zenith Data Systems Z-433DX Model 200
Overall weighted score		3.6	3.5	2.4	4.0	2.8	3.4
1. Price vs. performance	(30%)	4	4	2	4	3	4
2. Performance	(25%)	3	4	2	4	3	3
3. Expandability	(25%)	4	3	3	4	2	3
4. Serviceability	(10%)	3	3	2	4	3	4
5. Quality of construction	(10%)	3	2	3	4	3	3

1. Overall performance relative to cost (comparative among these six machines). 2. Overall comparative system performance in all tests. 3. Support for processor, memory, storage and expansion board upgrades. 4. Ease of processor, memory, storage and expansion board upgrades. 5. How well the system is assembled (including case design, power supply and tools required for assembly).

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- External PS/2 mouse port
- External VGA monitor port
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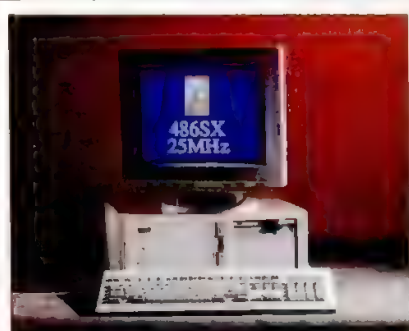
\$379

Standard Computer Corp.

Standard 486SX/25

Though Standard Computer Corp.'s \$1,895 486SX/25 didn't turn in an impressive performance sheet, the system is well designed and equipped with surprisingly high-quality components (including a top-rated MAG Innvision monitor), as well as a large array of bundled software.

The small-footprint case has ample expansion room, and Standard supplies a number of brand-name components, including ATI video, a Maxtor hard disk, and a 14-inch MAG monitor with a 76-Hz refresh rate. The monitor even features a degaussing but-



FACT FILE

Standard 486SX/25

Standard Computer Corp., 12803 Schabaram Ave., Irwindale, CA 91706; 800-662-6111, 818-337-7711; fax: 818-960-2926

List price (tested configuration): \$1,895.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 64K external cache.

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, Standard PM560DG ISA disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: ATI Graphics Ultra ISA video controller with 1MB VRAM, MAG LX1460 14-inch monitor with a 76-Hz refresh rate at noninterlaced 1,024-by-768.

Software: DOS 5.0, Windows 3.1; Ami Pro, Borland's Turbo C++, Turbo Pascal, Freelance Graphics, Generic CADD, Lotus 1-2-3, Norton Desktop, or Paradox.

In short: With quality components, a solid warranty, and a fax modem, this system is worth a close look.

520 ON READER SERVICE CARD

Standard 486SX/25

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

ton and pincushioning control. The unit also comes with an ATI mouse.

A minor internal annoyance is Standard's placement of its I/O ports. To overcome the lack of integration on the motherboard, Standard combined the hard disk and I/O controller, which might have saved them a slot on the system. But that potential advantage was negated when the engineers wired the I/O ports through the bracket for a neighboring 16-bit expansion slot. The I/O controller could be rewired—but not easily. The port housings seem integral to the retaining bracket, which means you will have to rehouse the ports before rewiring them.

Besides DOS 5.0 and Microsoft Windows 3.1, Standard's software bundle includes Norton Desktop for Windows 2.0 and your choice of Ami Pro 3.0, Borland C++ for Windows, Borland Turbo Pascal for Windows, Freelance Graphics, Generic CADD 6.0., Lotus 1-2-3 for Windows, or Paradox 4.0. Standard also throws in a 9,600-bps/2,400-bps fax modem for \$75 more.

Performance wasn't impressive. The system turned in average-to-below-average scores. Only its Windows graphics score managed an above-average ranking.

Standard offers a two-year parts-and-labor warranty, with on-site service available for the first year.—OR

Swan Technologies Inc.

Swan 486SX/25 V

Based on a 486SX/25MHz processor, Swan Technologies' \$1,995 Swan 486SX/25 V seems to be a favorable buy at first glance. But the Swan's less-than-solid monitor and dismal performance scores make it less than a steal.

The small-footprint desktop case is neatly styled and leaves plenty of room for drive expansion as well as accessibility to motherboard-mounted components. The system board is cleanly designed, with most essential components within easy reach—including the CPU and SIMM banks.

Inside, however, are indications of the motherboard's age. One is the presence

of two 8-bit expansion slots; most of the ISA machines we review nowadays are exclusively 16-bit. Also, if you need extra processing power and manage a chip-puller upgrade to a DX2/50 (provided your version doesn't solder the processor to the motherboard), you'll probably want to upgrade the secondary static-RAM cache from its minimum 64K. Since it's mounted on the motherboard, this is probably a job for a professional.

During our testing routines Swan's



FACT FILE

Swan 486SX/25 V

Swan Technologies Inc., 3075 Research Drive, State College, PA 16801; 800-468-9044, 814-234-2236; fax: 814-237-4450.

List price (tested configuration): \$1,995.

Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K external cache.

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, MID-400KF Motherboard disk controller, dual 1.2MB/1.44MB floppy disk drive.

Display: Diamond Stealth VRAM ISA card video controller with 1MB VRAM, Swan SW592 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: Dismal performance and an outdated motherboard count against the unit, but a clean interior and quality components count in its favor.

521 ON READER SERVICE CARD

Swan 486SX/25 V

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Expandability	GOOD

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair Service	ABOVE AVERAGE
Tech Support	ABOVE AVERAGE

own SW592 monitor required numerous readjustments before syncing to the Windows environment. This was made all the more difficult by the fact that the monitor's controls were awkwardly positioned in the rear.

Though it used the well-known Maxtor 7213AT 212MB IDE hard disk with a 64K cache and a Diamond Stealth VRAM card based on S3's new 86C911 chip, the Swan didn't do well on our benchmark tests. All scores were in the bottom echelon, with the lone exception of its Windows graphics score, which managed to edge just above the midpoint.

You'll probably be pleasantly surprised by Swan's warranty policy, however: Two years of parts-and-labor and free on-site service.—OR

Telemart

MIT S HSY-88-486DX-50

The \$1,999 MIT S HSY-88-486DX-50 offers one of the fastest processors in the low-cost group we reviewed for this story. But merely average scores on our disk test routines combined with weak graphics capabilities prevented the system from soaring to the top of the class.

The CPU achieved the second-highest rating on our processor test routines, right behind Unitek Technology's UT-486DX50C. You can tell Telemart is proud of the processor: The front of the case has an indicator for CPU speed. To boost speed even further for numerical calculations, there is also a coprocessor slot.

The Maxtor 212MB hard disk unfortunately won't help you maintain your speed if you are accessing storage; our disk tests placed the MITS in the middle range of machines, although its score was still a tad above average. And there's no cache memory on the Telemart hard disk controller.

Memory, however, fared better: The 70-nanosecond memory speed pushed up the unit's memory-access ratings to just shy of the top ten.

If speed isn't your goal, you may be disappointed by the screen. The 70-Hz



FACT FILE

MIT S HSY-88-486DX-50

Telemart, 8804 N. 23rd Avenue, Phoenix, AZ 85021; 800-835-1314, 602-944-0402; fax: 602-997-8737

List price (tested configuration): \$1,999

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Maxtor 7213AT 15-ms 213MB IDE hard disk with 64K cache, MITS-Telemart IDE Plus-V3 ISA card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: MITS JAX-8212 ISA card video controller with 1MB DRAM, Supercom SV 1486 14-inch monitor with a 70-Hz refresh rate at 800-by-600 noninterlaced resolution

Software: DOS 5.0 and Microsoft Windows 3.1.

In short: If speed is an important factor, the system features a top-notch processor and memory configuration.

ON READER SERVICE CARD

MIT S HSY-88-486DX-50

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

Supercom 14-inch 800-by-600 noninterlaced monitor doesn't achieve startling clarity. It is powered by a JAX video card containing the Trident TVGA chip set with 1MB of dynamic RAM. The MITS turned in a poor video score that landed it second from the bottom.

Elsewhere, there is little to recommend in the MITS. The third, fourth, and fifth slots don't accept full-length cards because those slots are blocked by the heat sink and the fan located on the CPU. Moreover, the I/O card shipped with the machine we reviewed did not function correctly and had to be replaced.

On the plus side, the motherboard is clean and well designed, and Telemart offers a nice warranty: Two years for parts and labor.—AC

Tenex Computer Express

Tenex Premier 486DX/33

The Tenex Premier 486DX/33 is a solid machine that placed among the top 25 percent in processor and memory speed on our benchmarks. But its crowded interior would make adding new components a tiresome chore.

There are seven drive bays in the Tenex Premier; five are external, one is internal and attached to the side of the power supply, and the other is also internal but sits under the power supply, where it is hard to reach. Because so many drive bays have been crammed into the unit's

rather tight internal quarters, gaining access to the cache, Weitek coprocessor socket, and jumpers—in order to select the CPU type—can be a bit of a hassle.

The DTK motherboard, which uses relatively few chips and jumpers, holds eight 16-bit slots, only two of which are occupied. If all the SIMM sockets were filled, three of the slots could accept only half-length cards.

The RAM on the motherboard has a rated speed of 80 nanoseconds, which is a bit slower than is common today, but the 64K of RAM cache has a rated speed of 15 nanoseconds, which is faster than most. As a result, the system scored in the top 25 percent on both our DOS processor and memory test routines. These results could be improved if you order the machine with the maximum 256K RAM cache. This will cost you an extra \$100.

Hard disk speed for the system was average under DOS and somewhat above average under Windows. The Premier's video test scores may have been below average, but the Boca Research video adapter supports 24-bit color, and the Samtron 14-inch monitor provides bright colors and a sharp image.

Tenex Computer Express offers a two-year warranty on parts and labor, free on-site service for the first year through Panda Technological Pro-

Tenex Premier 486DX/33

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR

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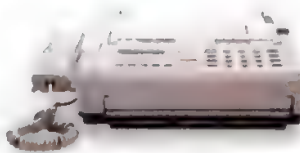


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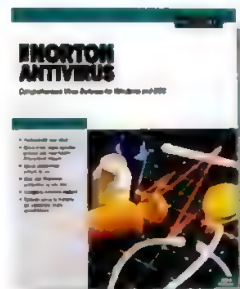
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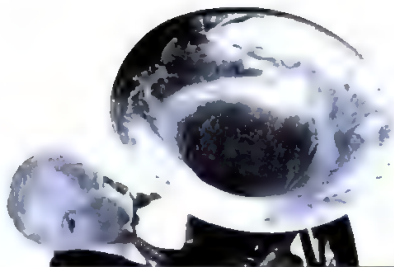
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486SX/25
Best Buy,
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486SX/33	INTEL 80486SX-33 MHz 8K CPU CACHE	4 STANDARD 32 MAX	80	AS ABOVE	16 BIT SVGA CARD 14" 1024X768 SVGA COLOR MONITOR	\$1,199 \$44/MO*
486DX/33 CACHE	INTEL 80486DX-33 MHz 128K CPU CACHE	4 STANDARD 32 MAX	120	1 2 & 1 44	16 BIT TRUE COLOR SVGA WINDOWS ACCELERATOR CARD WITH 1 MB RAM/ 14" 1024 X 768 SVGA NON-INTERLACED COLOR MONITOR	\$1,599 \$59/MO*
486DX/50 CACHE	INTEL 80486DX-50 MHz 128K CPU CACHE	4 STANDARD 32 MAX	200	AS ABOVE	AS ABOVE	\$1,999 \$74/MO*
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486SX/25
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October 13, 1992

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CIRCLE 13 ON READER SERVICE CARD



FACT FILE

Tenex Premier 486DX/33

Tenex Computer Express, 56800 Magnetic Dr., Mishawaka, IN 46545-7481; 800-776-6781, 219-259-7051; fax: 219-259-0300

List price (tested configuration): \$1,999.

Memory and processor RAM cache: 4MB 80-ns SIMMs, 64K external cache.

Disk drives and controller: Quantum LPS240 16-ms 240MB IDE hard disk with 256K cache, PTI 227B ISA card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Boca Research SVGA ISA card video controller with 1MB DRAM, Samtron SC-428TX 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: The crowded interior of the Tenex 486DX/33 would make expansion tough, but the unit's processor and memory ratings were quite good.



ducts Maintenance, and toll-free technical support weekdays and Saturdays.—HFW

Unitek Technology Inc.

UT-486DX50C

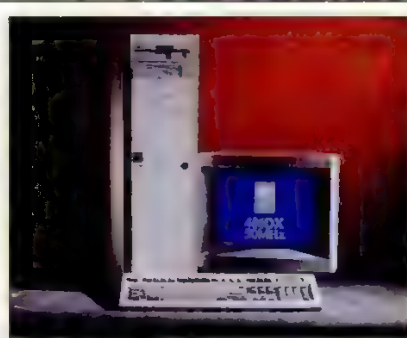
If you're looking for a cheap, powerful server, the UT-486DX50C EISA-based tower is an excellent choice. It has plenty of room for expansion, solid design, and superior performance—apart from its VGA showing.

Everything is easily accessible in the unit. All six of the 5.25-inch drive bays are external; all the switches are on the front. Inside, the bays, processor, memory, and eight 32-bit slots are unimpeded and easy to reach; even the wires are tied out of the way. Five of the slots are unoccupied. The Tyan Computer mother-

board is small and neatly laid out and will support up to 128MB of RAM and 512K of RAM cache. The unit came with 256K of cache to meet our \$2,000 limit; another 256K of cache would cost only \$65 more.

The excellent design translates into excellent performance for the most part. The system had the top score on our processor test routines and came in fifth on our memory test routines. Its disk test results were also quite good; the UT placed second under Windows and twelfth under DOS. Most of the credit for its disk results must go to the Unitek IDE controller, since the system's Western Digital 14-ms 213MB hard disk does not have a reputation for speed.

The one area in which the machine didn't fare well was video performance;



FACT FILE

UT-486DX50C

Unitek Technology Inc., 1917 Vineyard Ave., Ontario, CA 91761; 800-944-5650, 909-930-5700; fax: 909-930-5710

List price (tested configuration): \$1,995.

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital Caviar 2200 14-ms 213MB IDE hard disk with 64K cache, Unitek Technology, Inc. ISA card disk controller with 0 cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond Computer Systems SpeedSTAR SuperVGA ISA card video controller with 1MB DRAM, ViewSonic 8E 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: With the top score in processor speed, the UT-486DX50C would make an excellent server.



UT-486DX50C

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	EXCELLENT

it earned a Windows Graphics score that placed it in the bottom 30 percent of the machines we reviewed. The bright spot is the system's standard ViewSonic 14-inch monitor that has controls located on the front, a nice, clear image, and can support 1,024-by-768 resolution.

Unitek offers a lifetime warranty on labor and a one year warranty on its parts. Nationwide Warranty Corp. provides one year of free on-site service. Toll-free technical support is also available from 10:30 AM to 7:30 PM Monday-Friday and 1 PM to 6 PM on Saturday.—HFW

USA Flex Inc.

USA Flex 486DX-33MHz System

The \$1,995 Flex 486DX-33MHz System is a mixed bag, with a conflicting hodgepodge of excellent and poor-quality components. The unit consequently turned in a roller-coaster set of test scores.

The small-footprint desktop case is sturdily constructed, and key areas of the drive-bay assembly are fastened by clips for easy access, in case you have to remove or add a drive. The motherboard is clean, with only a few jumper switches (which control the size of the external processor cache). The SIMM memory modules and the processor socket are fairly accessible as well.

USA Flex's low-cost engineering showed a number of flaws. First, the company sent us this machine with a 34.5-MHz clock crystal, even though the processor is rated for 33 MHz. The company said all its systems are shipped with the higher-speed clock crystals, which are considered to boost performance. Intel Corp., which makes the processor, doesn't recommend pushing a CPU to a speed for which it wasn't designed; doing so could cause problems with excess heat, chip life, and system malfunctions. Our tests were performed using a replacement 33-MHz crystal.

USA Flex 486DX-33MHz System

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

Second, though the unit comes with a high-performance Diamond Stealth VRAM video adapter, USA Flex selected MAG Innovision's low-end Flex-Vision D1-1448 monitor instead of MAG's justly popular MAG MX-15. The D1-1448 monitor, featuring rear-mounted image controls, is a 14-inch model capable of only a 60-Hz refresh rate at 1,024-by-768 resolution.

Performance is a difficult call. While the Flex managed to land its Windows disk score into the top ten, its DOS video and memory scores dropped into the bottom fifteen, which also caused its overall DOS score to drop. All other scores were unremarkable. Before buying this system, consider your applications' hardware needs carefully.

USA Flex offers a one-year parts-and-labor warranty, with a year of on-site service thrown in as well.—OR



FACT FILE

USA Flex 486DX-33MHz System

USA Flex Inc., 471 Brighton Dr.,
Bloomington, IL 60108; 800-955-1497, 708-
351-9700; fax: 708-351-7204

List price (tested configuration): \$1,995.

Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, integrated controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond Stealth VRAM ISA card video controller with 1MB VRAM, MAG Innovision's FlexVision D1-1448 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: This system combines intelligent engineering choices with those that aren't so smart, such as its inclusion of a pushed clock crystal.

ON READER SERVICE CARD

Zenith Data Systems

ZDS Z-425SX Model 200

Zenith Data Systems' \$1,999 model managed to sneak in beneath our price limit, but it didn't quite measure up to the best of the rest. A below-average video subsystem and limited expansion possibilities mean Zenith should have taken a closer look at this one.

The small-footprint desktop case promises some space for the future, but users will probably be disappointed when they venture inside. Granted, most of the

The Z-425SX Model 200's

*small-footprint case
promises space for the
future, but users will
probably be disappointed
when they venture inside.*

system's essential circuitry has been integrated (including the usual I/O ports and video- and drive-controller circuits), which means that the five vertically mounted 16-bit expansion slots are empty. But most small-footprint designs manage more than five expansion slots on the motherboard and hence don't need vertically mounted slots. Here, this feature will probably annoy most users, located as it is in an uncramped interior.

Also, there's an alternative processor socket for a CPU upgrade—one of the few we found in this roundup. But while some users may want to jump to a DX2/50 from the system's 486SX/25, they'll probably be frustrated by the lack of support for an external pro-

ZDS Z-425SX Model 200

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Expandability	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	BELOW AVERAGE
Repair Service	BELOW AVERAGE
Tech Support	BELOW AVERAGE



FACT FILE

ZDS Z-425SX Model 200

Zenith Data Systems, 2150 East Lake Cook
Road, Buffalo Grove, IL 60089; 800-582-
0524; 708-808-5000; fax, 800-582-8194

List price (tested configuration): \$1,999.

Memory and processor RAM cache: 4MB 70-ns SIMMs.

Disk drives and controller: Western Digital Caviar 2200 14-ms 200MB IDE hard disk with 64K cache, integrated disk controller integrated on motherboard, 1.44MB floppy disk drive.

Display: Integrated ZDS SVGA video controller with 512K DRAM, ZDS ZCM-1430 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution.

Software: DOS 5.0, Microsoft Windows 3.1.

In short: ZDS manages to come in under our price limit, but the unit skimps a little too much on system internals—especially on its video subsystem.

ON READER SERVICE CARD

cessor cache, which is almost mandatory for clock-doubling chips.

The integrated video was also a little sluggish, using only 512K of dedicated memory and a last-generation Western Digital 90C30 chip set (Western Digital Corp. recently came out with its well-received 90C31). The Zenith monitor disappointed as well, with only a 60-Hz refresh rate at 1,024-by-768 noninterlaced resolution, an incomplete complement of awkwardly positioned rear-mounted controls, and serious difficulty when adjusting brightness.

Most test scores were either average or below average, and the DOS processor and Windows graphics scores were well below average (the latter actually placed the unit last).

Zenith has recently revamped its service department and offers a one-year parts-and-labor warranty.—OR □

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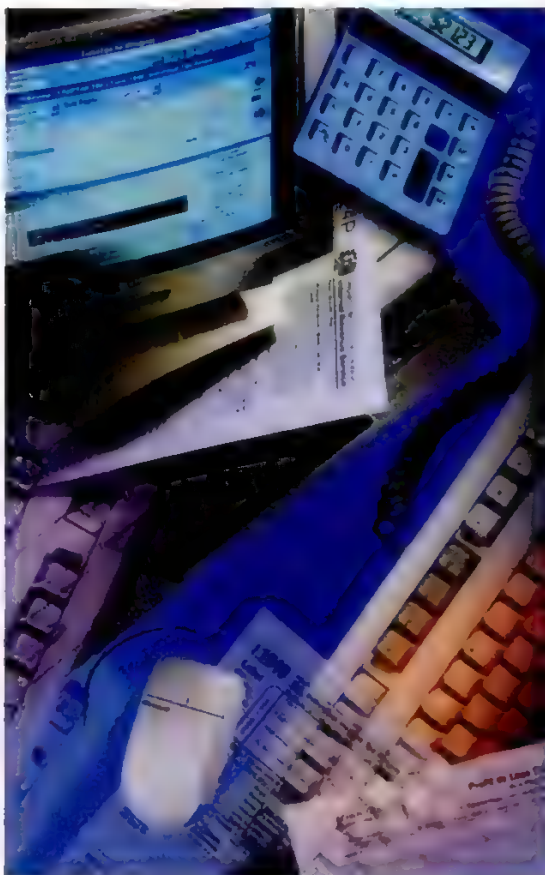
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If someone tried to sell you a software product that you'd use only for a few hours, that you'd have to replace annually, and that could wind up costing you a bundle of money if you (or it) messed up, would you buy it?

Millions of people do, people whose income tax returns are complex or confusing enough to create significant amounts of frustration and anxiety, but not so complicated that they need to hire a tax professional.

Indeed, tax preparation programs designed for individual taxpayers—the ones we'll be looking at here—don't pretend to replace financial professionals, but clearly understood and correctly used, they can take a lot of pain out of doing the tax dance.

The most typical candidates for these products could probably fill out their forms and schedules by hand if they had to (albeit with an occasional bout

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by Kathy Yakal

Personal Tax Preparation

of hair pulling, a frantic phone call or two, and consultations with reference books). While the products we review here are theoretically capable of processing quite complex returns, potential users should understand that with complexity come increased chances of significant legal and/or financial blunders. They should always keep in mind the option of consulting a professional if *any* doubt arises.

TAX SOFTWARE CAN HELP

Let's move from generalities to a detailed look at what personal tax preparation software can offer.

First, the best tax preparation programs serve as interpreters between you and the complicated rules and procedural language employed by the IRS to explain what's required on your tax forms and schedules. Some, like Personal Tax Edge and TurboTax, contain actual IRS instructions on-line; even better, they explain those instructions in plain, understandable English.

Tax programs also help eliminate duplication of data entry. Type in your name, address, and Social Security number once, and the program inserts the information wherever it's needed. That goes for any other word or number that has to be entered in more than one place on the return. This not only saves time, but it also reduces errors: When you do

your taxes manually, every time you fill out a supporting worksheet or schedule and transfer the appropriate number to a field on another form, there's a chance you'll make a mistake.

Further, like good professional tax

Tax programs for individuals don't replace professionals, but correctly used, they take a lot of pain out of the tax dance.

preparers, good tax programs try to find every single legal deduction that could result in a lower tax obligation (though they're not absolutely comprehensive in this respect). The best programs also offer features that comb your completed return for unfinished forms or fields, any numbers that the IRS might question, and other miscellaneous discrepancies. Some, like EasyTax and Andrew Tobias' TaxCut, compare your income, expenses, and tax liability with U.S. averages. While these reviewing functions are not as thorough as a face-to-face IRS audit, they can help you check the accuracy of your return.

SIMPLIFYING THE MAZE

The best of the software tax products clarify the big picture, helping you to understand how every supporting schedule and worksheet flows back into the main 1040 Form. And while, as you would expect, the software handles all of the major calculations automatically, you usually end up needing to do some offstage calculations in order to tally line-item totals and the like. Good tax programs give you tools to help with that: pop-up calculators, notepads that you can attach to a field for later reference, and "shoebox" or "file cabinet" features that direct you to the proper place on the proper form for a particular piece of financial data (a medical expense or charitable contribution, for example).

While they don't sign their own names to the return (or take legal responsibility for the information entered there), good tax packages do help you review your return after you've completed it, alerting you to incomplete documents and flagging fields whose entries might trigger an IRS audit. Again, some let you compare your major income and expense categories with U.S. averages. Two vendors—ChipSoft and MECA Software—actually promise to pay any IRS penalties that are incurred if their programs make calculation errors.

These products also more or less elim-

Suitability to Task: Personal Tax Preparation Software

Tax preparation software can help eliminate much of the frustration of tax preparation and filing by guiding you through your tax chores and preparing the actual returns. We looked at nine tax packages, examining their preparation tools, guidance for the end user, filing capabilities, and accuracy. In each category, we evaluated ease of use and comprehensiveness of features.

We looked carefully at the tax **preparation** capabilities of each program. If a product includes complete representations of the most commonly used forms, calculates them accurately, and guides users to fill out supplemental forms and schedules where required, we have rated it at least *fair*. To garner a higher score, a program has to go beyond that, sup-

porting the import of financial data from a variety of money management programs and offering automatic links to supporting forms, schedules, and worksheets. A top-rated program must also provide an interview option for data entry or an electronic organizer for classifying miscellaneous income and expenses—or both—as well as helpful utilities such as a pop-up calculator and notepads or bookkeeping tools.

In evaluating each program's **guidance** elements, we asked: Are the explanations of tax law available at the precise time a user is likely to need them? Are they easy to find? And—most important—are they understandable and thorough? A high score indicates that the program's designers were able to make the IRS's often incomprehensible instructions comprehensible. The best programs help you pare down your tax debt by offering tax-saving suggestions. They also let you explore alternative tax-filing options by building "what if" scenarios that compare your return against U.S. averages and compare the results of fil-

SUITABILITY TO TASK				
Product Name				
	POOR	FAIR	GOOD	EXCELLENT
Preparation	●	○	○	○
Guidance	●	●	○	○
Filing	●	●	●	○
Filing	●	●	●	●

ing separately versus filing jointly with your spouse. The best programs also offer ways to audit and review your completed return, checking for omissions and entries that might trigger an IRS audit.

Filing rates a program's ability to create IRS-approved forms on a variety of printers without requiring additional software or font cartridges. The ability to print exact IRS-replica forms is a real plus in some packages. Top-ranked programs also offer an easy path for electronic filing and do not charge any fee beyond the IRS filing fee.



EDITORS' CHOICE

- TurboTax for DOS
- TurboTax for Windows

inate those frantic last-minute trips to the IRS office to pick up new, clean forms after you've messed up the two sets you already brought home. Tax programs print your completed returns for you. Depending on the printer you use, many packages can create excellent replicas of official IRS forms. In fact, products that use Microsoft Windows 3.1's TrueType fonts produce forms that look even better than the genuine IRS versions. Most packages produce forms that are at least acceptable to the IRS. Electronic filing via modem, an option that is being offered by more and more tax packages, eliminates the need for forms and printing altogether.

ONE GOAL, MANY PATHS

The tax preparation products reviewed here offer a wide variety of styles and contents, varying from bare-bones, fill-in-the-blanks packages such as TaxBreak to products such as TaxCut and TurboTax, packages so feature-packed and helpful that they do practically everything but lick the stamp and mail the envelope.

All of the vendors whose products we reviewed for this article released what they call early-bird or head-start editions of their programs in the fall of 1992 (as most tax software vendors usually do every year). Though tax products cannot appear in final version until the IRS publishes its forms for the tax year in January, these versions look and work much as the final versions will. We reviewed these early versions, not the final versions that appear in January or February, to allow this article to get into print well before the IRS's April 15 filing deadline.

So while these early editions contain preliminary forms and sometimes require additional refining of printing and help capabilities, they're generally feature-complete.

Why buy an early-bird edition? Because it provides an opportunity for you to plan ahead. In fact, many of the prod-

Two names have long been synonymous with excellence in personal tax preparation software: TaxCut and TurboTax. MECA and ChipSoft—their respective vendors—have improved their programs every year and have consistently been named favor-

ites by the majority of tax software users. Both products are trustworthy and easy to understand and use for beginners and experienced users alike; both offer credible guidance, a clear interpretation of confusing IRS tax laws, and tax-saving tips.

TaxCut has introduced a spate of new features this year. It includes more forms; richer, deeper Interview and Audit options; easier import capabilities; more font flexibility; smoother compatibility with state editions; and many other operational enhancements.

That said, MECA's 1992 editions of TaxCut just don't bear comparison with the startling evolutionary movement evident in ChipSoft's 1992 TurboTax products. ChipSoft's commitment to rebuilding from the ground up the parts of the program that needed improving (rather than just tacking on new features or enhancing existing ones) has moved TurboTax decisively ahead of its market rival this year.

The new EasyStep data entry option is the absolute clearest path we have seen provided for users of tax

preparation software. The interface design is, for the most part, very clean. There is not a lot of unused or poorly used screen space, and the combination of menus, command bars, and buttons rarely leaves you confused about your next move. The implementation of EasyStep in TurboTax for Windows is exceptional; this package looks and feels like a state-of-the-art Microsoft Windows program. At the same time, ChipSoft has managed to maintain and even enhance the classic approach to data entry, which should please longtime TurboTax users. Several important operational changes have been made to individual features, too.

No tax program designed for such an eclectic audience as the general public can be absolutely comprehensive. Nor can it hope to fully clarify a set of laws and procedures that keep even the professionals guessing. Both ChipSoft and MECA have made admirable efforts in these difficult directions year after year, but TurboTax is clearly the best of the 1992 tax preparation programs.

ucts we reviewed do suggest financial action you might take before the end of the year to lower your tax bill. And the time you've spent entering preliminary data in the early version won't be wasted, since the data transfers directly to the final version.

EASY INTERVIEWS

The "traditional" form of data entry for tax packages is the forms method, in which you are given a screen picture of each form or schedule and you simply fill in the blanks with information from your

records. Probably the most important development we've seen in tax programs in recent years is the evolution of the "interview," an alternative procedure for entering your basic tax data.

Instead of leaving you to puzzle out the meaning of each line on a tax form (and whether it applies to you), the interview process leads you through a series of simple, specific questions that spell out exactly what information is required at a particular point. The program takes your answers—prompting for further details when appropriate and performing

Our Contributors: KATHY YAKAL

is a California-based computer journalist who has covered the PC industry since 1983. TED STEVENSON was the associate editor in charge of this story, and BEN Z. GOTTESMAN was the project leader.

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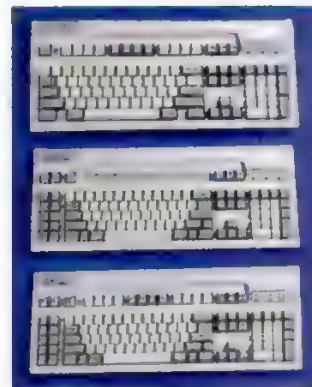
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the required calculations—and deposits them in the right places on the right forms. About half of the products that are on the market today offer an interview option.

The level of questioning detail varies among programs. Where one might simply ask, "Did you make any cash contributions to charitable organizations last year?," TurboTax, for example, digs deeper, ticking off a list of possible recipients. Did you contribute cash to the United Way? The Heart Fund? Did you make any noncash contributions?

AUDIT PROOFING AND SO FORTH

It's common sense that documenting the figures you enter into your tax returns should pay big dividends in time and anguish saved if you're ever audited. We are happy to note that some packages now give you tools to do this. A good example is Personal Tax Edge's Bookkeeper feature, which pops up a worksheet where you can enter a list of itemized expenses, tally them, and place the total in the current field. The list remains attached to the field for later reference. Most of today's packages provide at least a notepad that lets you attach reminder notes to particular line items.

Of course, using personal financial management software to document your tax figures might be an even better solution—especially if you can then export your annual totals directly to your tax program. Happily, this is becoming easier. TaxCut and TurboTax, in particular, have made notable improvements in their import capabilities since last year. For details, see the sidebar "Money Managers Aid Tax Prep."

Other improvements in this year's crop of tax preparation packages include a bigger selection of forms (in almost every case); clearer interpretations of IRS regulations; less cumbersome, more fluid mechanisms for moving freely among the various forms and schedules that make up a return; and the enhancement of guidance features without forcing advice on the user—a difficult balancing act.

ONE-CLICK TAXES?

An executive with one tax software vendor represented here said he would like to see tax preparation become a "non-event" some day. We may be moving toward a day when everyone will have an easy-to-use, all-purpose financial management package with a menu option called Tax Preparation—a few clicks and you're done for the year—but we are not there yet.

Oddly, many of the improvements we'd like to see along the road to totally effortless taxes are the same improvements we were pleased to see this year—only more so: still more forms (a trip to the IRS office is as irritating for one form as for the whole bundle); more depth

and insight in audit capabilities; more comprehensive and consistent interview techniques and a more fluid interplay between interview and line-by-line data entry; and finally, a freer structure of the whole, decidedly nonlinear, process of creating a tax return.

BE CONFIDENT BUT CAUTIOUS

Meanwhile, by all means take advantage of today's tax software. True, the products aren't yet perfect—and for that reason it's important that you check your work carefully before you sign and mail the forms—but the best of them are very good indeed. Read on for details on the 1992 crop of personal tax preparation packages.

AM Software Inc.

AM-Tax Personal 2

ALL REVIEWS BY
KATHY YAKAL

Though it may not seem so at first glance, AM-Tax Personal 2 (\$65), from AM Software, is more than just an electronic version of a tax return. Sure, it's not the most full-featured program we looked at, but it's not an absolute lightweight either. If you're comfortable enough doing your return by hand and don't mind occasionally consulting a tax manual for detailed

instructions, and if you're not looking for a program with a snazzy state-of-the-art user interface, AM-Tax may meet your needs just fine.

To prepare a return using AM-Tax, you enter data directly into fields on the 1040 and supporting forms, schedules,

SUITABILITY TO TASK				
AM-Tax Personal 2				
	POOR	FAIR	GOOD	EXCELLENT
Preparation	●	●	○	○
Guidance	●	○	○	○
Filing	●	●	○	○

and worksheets. When you come to the bottom of a screen, you must hit PgUp or PgDn to get to another screen of the document. We found the inability to scroll smoothly through an entire form or schedule a little irritating at first.

You navigate through the return using function keys and keystroke combinations. Function keys give you access to program help, supporting forms and schedules, the override feature, and the main menu (a dialog box that lets you delete, save, view, etc.).

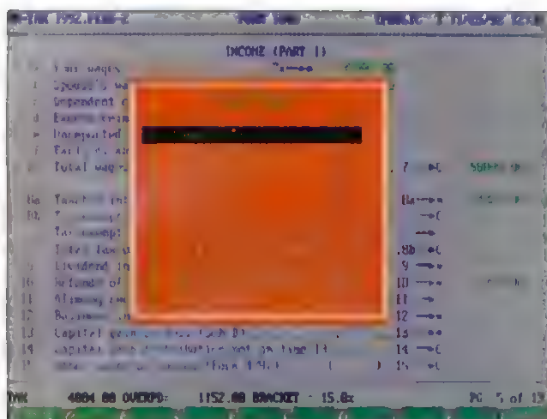


WHAT'S NEW

AM Software has added several features since last year. AM-Tax has new federal forms, including the 1116 (Foreign Tax Credit) and the 8829 (Business Use of Home). New worksheets help you calculate self-employed earned income for Schedule EIC, the self-employed health insurance deduction, and "other income" on 1040, line 22. Also in the 1992 edition, Schedule K-1 replaces the partnership worksheet; it flows directly to the correct forms. And Form 6251 (Alternative Minimum Tax) is generated when excessive deductions, accelerated depreciation, or net operating loss is present.

Tax preparation has been streamlined thanks to some other enhancements. For example, rather than highlighting every form or schedule you want processed or printed, one keystroke signifies a batch job. If you start filling out the 1040A and realize you need to use the 1040 instead, you can transfer all of the data already

Personal Tax Preparation



AM-Tax Personal 2 uses a simple DOS-based user interface to allow direct entry of data on forms and schedules.

entered, rather than starting over. Notebooks—blank, ruled worksheets that calculate—can be added to any tax return; these print out at the end of the return. And when you fill out a multipage form that has no data beyond the first page, you can opt not to print the second page.

AM Software has also enhanced the error-checking capabilities of AM-Tax in regard to certain deduction limitations. For example, it recognizes that you can't take a \$3,000 IRA deduction. One of the new checks added this year will alert you if you're trying to claim a deduction for contributing more than 50 percent of your adjusted gross income to charity.

Several cosmetic changes have been made since last year too. Fields that require a hyphen (Social Security numbers,

phone numbers, and so forth) are automatically hyphenated as you enter them. Tax figures print in a larger font size.

ON THE OTHER HAND...

There's a lot missing in this product when you hold it up against the top tax contenders. While the manual contains brief explanations of every field in the 1040 and supporting forms and schedules, there are no context-sensitive IRS instructions (or interpretations of them) in the program itself. There's also no way to further

detail data entered within the return and

no bookkeeper or notepad that pops up at the line where the explanation is needed. The program does not offer mouse support, and the default screen is made up of an ugly, difficult-to-read color combination (though you have the option of changing colors).

There are no built-in audit functions for checking your work after you've entered your return. Alt-R reviews your return, but all this gives you is a list of the forms you've used, with a line explaining where all your data is inputted on the 1040. Alt-T gives you a tax summary, a running tally of totals such as income, deductions, and expenses.

An electronic filing version of AM-Tax is available; forms are transmitted to

■ How We Tested: Personal Tax Software

To test the tax preparation programs in this review, we ran each product through three separate scenarios representing families with different income levels and degrees of tax-return complexity.

In theory, these packages are capable of processing more complex returns than the ones we looked at. But we focused on the needs of people whose relatively uncomplicated income and expense structures made them reasonable candidates for personal tax software, as opposed to the services of a CPA.

Our simplest scenario involved a couple with no dependents. Together, their W-2 income totaled \$50,000. They received taxable interest and paid home mortgage interest, contributed to IRA accounts, and made charitable contributions. For this couple, a tax package should produce Form 1040, Schedules A (Itemized Deductions) and B (Interest and Dividend Income), and Form 8283 (Charitable Contributions).

In our second scenario, a married couple with one child earned \$75,000; both are self-employed. They rent their home and use two rooms as offices. They had medical and business

expenses and day-care costs, and they had paid estimated taxes during the previous year. Their properly prepared return consists of Form 1040; Schedules A, B, C (Business Profit or Loss), and SE (Computation of Self-Employment Tax); Form 2441 (Child and Dependent Care Expenses); and Form 8829 (Expenses for Business Use of Home).

In our third and most complex scenario, a married couple with two children earned almost \$120,000 between his W-2 income and her business. Their medical expenses were unusually high, so they sold some stock to pay the bills. They own a small rental cabin that took a small loss. Their completed tax return should include Form 1040; Schedules A, B, C, D (Capital Gain/Loss), and E (Supplemental Income and Loss); and Forms 8283, 8582 (Passive Activity Loss Limitations), 6251 (Alternative Minimum Tax), and 4562 (Depreciation and Amortization).

When our programs generated an answer that deviated from what our research indicated was correct, we consulted with the vendors' research departments and with tax professionals to track down the discrepancy. □

▶ FACT FILE

AM-Tax Personal 2

AM Software Inc., 1500B NW Vivion Rd.,
Kansas City, MO 64118; 816-741-7848;
fax, 816-741-1517

List price: \$65 (limited shareware version available for \$20), state programs, \$30 each

Requires: 640K RAM, 750K hard disk space, DOS 2.0 or later

In short: AM-Tax Personal 2, from AM Software, can generate simple and complex tax returns well, but it does not provide the novice any kind of guidance or interpretation of IRS tax laws and instructions. This program is not recommended for the novice, but it is fine for uncomplicated returns and users who are tax savvy. It's not the most full-featured program, but it's not a lightweight either.

ON READER SERVICE CARD

■ Ten Tips to Ease Tax Pain

by Kathy Yakal

There are two kinds of potential pain that people associate with tax season. First is the despair they feel at 2:00 A.M., when they think they've finally completed their return, only to find a file folder stuffed with medical receipts that they'd forgotten to include. Second, and much more painful, is the frustration taxpayers experience when, after all their work, they see a large number on line 64 of the Form 1040 ("Amount you owe").

Tax preparation software can't work miracles, but it can help minimize both kinds of trauma (emotional and financial). You'll have to do some of the work yourself; here are some suggestions.

1.) Record everything—every penny you spend on anything, whether or not you think at the time that it might be deductible.

Be meticulous about categorizing transactions, even if you can't imagine you'll ever forget what a particular check or deposit or cash receipt was for. If you keep track of your finances manually, set up a paper system that you use solely for income and expense tracking, one that offers both a ledger-type sheet to enter the transactions in columns and an envelope or pouch for storing receipts. Fill in the little comment lines on credit card slips and the memo line on checks to remind yourself where your money went.

Use personal finance software for your record-keeping (see "Money Managers Aid Tax Prep"). Many of the tax products reviewed here can import your financial data directly from these money management programs, which can speed tax preparation tremendously.

2.) Don't wait until April 14 to process your tax return, even if you've followed suggestion 1, above. In fact, don't wait until the next tax year. Start in the fall.

Buy early editions of tax programs, or start estimating on your own. You might find that you can significantly alter your tax debt by taking action before December 31. For example, if you're self-employed and find you've made more money than you anticipated, buy that new laser printer in December so you can claim it as a business expense on your Schedule C.

3.) No matter how thoroughly you've explored your financial portfolio for tax breaks, consult your tax prepara-

Record every penny you spend, whether or not you think at the time that it might be deductible.

tion product for further advice. Did you know, for example, that you can deduct mileage if you've driven your vehicle to benefit a charitable organization? Or that you can deduct travel and lodging costs for trips taken to receive medical care? The allowable deduction rates for these are lower than what's allowed for business travel, but they are indeed deductible. Every penny you can find legally will take you closer to an allowable deduction.

4.) Tax preparation products normally include a file that spells out major changes in the tax law for the current year. Though the IRS has until sometime in January to release final versions of forms, alterations in the tax law are generally known by the time the early-bird editions come out. These may or may not affect you, but a good tax package gives you a way to find out.

5.) Install your tax package before the day you plan to use it, and spend some time familiarizing yourself with it.

Learning a new software package and dealing with heady IRS instructions in the same afternoon is definitely not a good plan. Read the manual, print out the README files, and look at the tutorial if one is offered. Make sure the program makes sense to you before you sit down to generate your return.

6.) Try to get through the entire return once—in one sitting—and generate a preliminary 1040. Set aside a block of uninterrupted time for this, and respond to every question that you can answer with confidence. Then look over your rough drafts, scanning visually for major omissions, and run any reviews or audits offered, even if you know you're not done yet.

7.) If your return is relatively simple, using a product's Interview option may actually slow you down. Just to make sure you haven't missed anything significant, run quickly through the interview questions after you've finished your return.

8.) If you call the vendor for support, have your software running at the point where you have experienced trouble. Try to call at times during the day when they are less likely to be swamped; some manuals even spell this out for you. If the vendor offers fax support or help via forums on on-line services such as CompuServe or GENie, use them.

9.) Understand that you may need to ask for help. If you absolutely can't figure something out using the resources offered by the software and its vendor, contact a financial professional (a piece of advice that even the vendors of these products offer).

10.) Once you've finished your taxes, use the experience you've gained to set up or refine your record-keeping for the next year. □

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CIRCLE 365 ON READER SERVICE CARD

Personal Tax Preparation

Nelco. If you simply want to print your forms, the product is compatible with Nelco overlays and preprinted tax forms. It prints returns on plain paper on any dot matrix or laser printer (not exact replicas, but IRS-approved). If you want to print exact replicas, you'll have to purchase additional software—software that requires an HP-compatible printer and T-fonts (fonts designed especially for printing tax forms).

AM-Tax capably calculated all the scenarios we ran. If your tax return is at all complex and you're not very familiar with tax law, though, you may want to steer toward one of the products that offer more guidance.

SoftKey Software Products Inc.

EasyTax

It may not be the flashiest tax preparation program in our group, but EasyTax (\$79.95) is a solid tax preparation product. Former publisher Timeworks sold the product to SoftKey Software Products, and, happily, SoftKey's only changes are positive ones. EasyTax maintains the same understandable user interface and thorough approach to tax preparation and planning.

SoftKey offers what it calls an Interview option for data entry, but unfortunately, it is quite brief and does not go beyond a group of questions that determine which forms you will need to fill out. As a matter of fact, no help is available either on-line or in the manual for the interview process; so until you have completed it and are ready to start working on the forms, you're on your own.

Nevertheless, you're not likely to get confused by the EasyTax program. As you work your way through each form and schedule, you can do most of the navigating that is required by using the cursor and function keys.

In fields that already contain a default answer (that is, yes or no), you can toggle to the right answer using the Spacebar. The menu bar across the top gives you access to all of the program's features,

and shortcuts for its frequently used functions are displayed at the bottom of the screen.

If you're at a line on the 1040 that requires a supporting form or schedule, hit F5 and the program takes you there. F4 takes you to the previous form or schedule, and F7 lets you override the data there. Alt-X pops out a cross-reference box that tells you where any linked data would be (without opening the form).

STILL EASY

Though the Interview option in EasyTax isn't as strong as those in other packages, its preparation, guidance, and advice features are top-notch. These functions are found in the Help and Utilities menus.

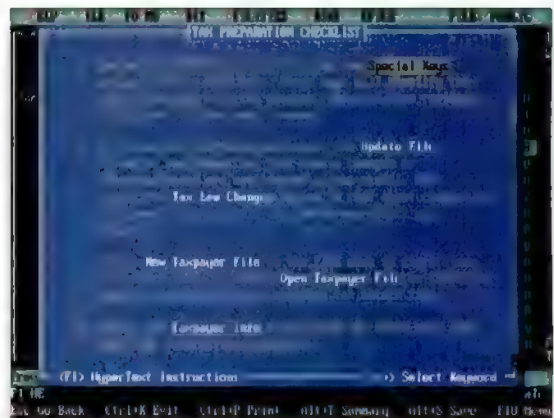
Before you even look at your first form, you can open the program's Tax Preparation Checklist; this gives you step-by-step instructions for using the program. You can either print this out or continue to refer to it on-line as you proceed through the program.

Helpful Hints outlines different attack strategies to minimize the time spent preparing your return. Quick Tour—new in this year's version—will give you a brief run-through of the program's operations. The Tax Information Flow Chart displays a clear graphical picture of the progress of data as it flows from one form to another.

While the moving arrows are kind of fun to look at, we didn't find this visual feature particularly clear, and it didn't offer explanations that weren't readily available elsewhere in the program.

A BOX FOR COMFORT

Some of these features are designed to be used in the process of preparing a return. The Shoebox contains a list of several dozen income and expense items. Click on one, and the program jumps to the form and line where that item should be entered. Want to know every place where a particular element of your finances will be used on your return? Select the Tax Categories feature and choose from the list provided there, and you'll see a list of the forms and schedules that use that data.



EasyTax provides guidance in a number of ways through features such as its Audit Alert and "what if" scenarios.

Still confused about exactly where everything goes? Select Tax Forms, and you will see a list of all the tax categories covered by every form and schedule. If you can't complete your whole return in one sitting, the program's Electronic Place Mark makes it easy to pick up where you left off in the tax preparation process.

SUITABILITY TO TASK				
EasyTax				
	POOR	FAIR	GOOD	EXCELLENT
Preparation	●	●	●	○
Guidance	●	●	●	○
Filing	●	●	●	○

Once you think that you have finished, EasyTax offers a number of ways that you can check your work. The Data Integrity Check locates and lists potential problems such as missing fields and incorrect state abbreviations. U.S. Averages shows average medical expenses, tax liabilities, interest income, and contributions for different levels of adjusted gross income.

TIPS APLENTY

Tax Tips provides understandable explanations of IRS instructions. Year-End Tax Strategies helps you find ways to cut your tax debt.

A new feature in the 1992 edition, Tax Forecasting, allows you to calculate a rough estimate of what your 1993 taxes might look like.

EasyTax prints IRS-approved forms on both laser and dot matrix printers with no additional fonts or cartridges required. And the last item on the main



Do You Make These Six Common Mistakes On Your Taxes?

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Six common mistakes can cause you big headaches on your taxes. An oversight here, an omission there. From unnecessary tax payments to full blown IRS audits -- you can end up paying too much ... or worse.

But now, using TurboTax and your personal computer, you can avoid these simple but costly mistakes:

1 The Arithmetic Error

Today, even the simplest forms contain complex calculations. And with all the late-night scrambling, an innocent mistake could cost you plenty.

2 The Transcription Error

With all those numbers being juggled from schedule to schedule, it's no wonder the figures are so often transcribed incorrectly or entered on the wrong line.

3 The Omitted Form

Even "ordinary" returns require anywhere from six to a dozen forms to complete. It's easy to miss one ... or end up rushing all over town to find the one you need.

4 The Misinterpreted Instruction

At best, IRS instructions can be tough to understand. At worst they can be mind-boggling. What you need are clear directions in plain English.

5 The Overlooked Deduction

You'd have to be a professional tax preparer to know all the deductions you're entitled to. If you miss just one, it could cost you hundreds of dollars.

6 The Exceeded Guideline

The fastest way to trigger an IRS audit is to exceed the "normal" range on one of your deductions. You need to know what the IRS looks for on a line-by-line basis.

When you do your taxes with TurboTax, mistakes like these are virtually impossible. And filing your taxes couldn't be easier.



America's #1 Tax Software

TurboTax is America's #1 best-selling tax software -- over seven million returns were filed with TurboTax last year! With TurboTax on your PC (or MacInTax on your Macintosh) and the new EasyStep™ tax preparation process, you can completely and accurately prepare your income taxes in just a few hours.

Here's how easy it is!

- A. Gather your records and receipts.
- B. Enter your data into TurboTax.
- C. Print out, sign and drop in the mail.

TurboTax does the rest. Even if your records and receipts aren't in any particular order,

TurboTax's new EasyStep system will guide you every step of the way. And like a good tax advisor, TurboTax helps you identify every deduction you can claim.

Then TurboTax makes all the calculations, checks for accuracy and consistency, and transfers every number to the proper lines on the proper forms. And, TurboTax prints every form you need in IRS-approved format right on your own printer -- ready to sign and mail (or file electronically, if you prefer, for a faster refund).

PC Magazine says TurboTax "makes doing your taxes almost fun." Try it for yourself. We know that if you try it, you'll never go back to doing your taxes the old-fashioned way. In fact, we back TurboTax with our Double Guarantee:

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SOFTWARE
Personal Tax Preparation

► **S U M M A R Y O F F E A T U R E S**

Tax Preparation Software

PC EDITORS' CHOICE

Products listed in alphabetical order	AM-Tax Personal 2	Andrew Tobias' TaxCut	EasyTax	Personal Tax Edge	TaxBreak	TaxPerfect Personal 1040	TurboTax
■ = YES □ = NO							
General Features							
List price	\$65.00	\$79.95	\$79.95	\$49.00	\$39.95	\$99.00	\$79.95
Professional version available	■	□	□	□	□	■	■
Mouse support	□	■	■	■	□	□	■
Context-sensitive help	□	■	■	■	■	□	■
Software Features							
Pop-up calculator	■	■	■	■	□	■	■
Built-in notepad	■	■	■	■	□	□	■
"Shoebox" feature for organizing receipts	□	■	■	■	□	□	■
"What if" analysis	□	■	■	■	□	□	■
Financial managers or tax preparation programs from which product imports data	None	CheckFree, FOX, Managing Your Money, Microsoft Money, Quicken, TurboTax, programs that support TXF	Dollars & Sense, Managing Your Money, Quicken	Managing Your Money, Microsoft Money, MoneyCounts, Quicken	None	None	DOS version: Quicken, programs that support TXF; Windows version: CheckFree, Microsoft Money, Quicken, programs that support TXF
Tax Help							
Interview feature	□	■	■	■	□	□	■
On-line tax-saving tips	■	■	■	■	□	□	■
On-line IRS instructions	□	■	□	■	■	□	■
Tax planning for 1993	□	■	■	■	□	□	■
Audits final return	□	■	■	■	□	■	■
Compares return with a national average	□	■	■	■	□	□	■
Forms Preparation							
Number of forms and schedules included	60	85	66	52	35	57	DOS version: 90; Windows version: 100
Additional state versions available	AZ, CA, CT, DC, GA, IL, IN, KS, KY, MA, MD, MI, MN, MO, NC, NJ, NY, OH, PA, SC, VA, WI	AZ, CA, CO, CT, DC, FL, GA, IL, IN, MA, MD, MI, MN, MO, NC, NJ, NY, OH, OR, PA, TN, VA, WI	AL, AZ, CA, GA, IA, IL, IN, KS, KY, LA, MA, MD, MI, MN, MO, NC, NJ, NY, OH, OK, PA, SC, VA, WI	All states except Hawaii; also DC	None	None	DOS version: all states and DC; Windows version: CA, CT, DC, IL, MA, MD, MI, MN, NC, NJ, NY, OH, OR, PA, VA
Cost per state version	\$30.00	\$24.95	\$29.95	\$49.00	N/A	N/A	\$49.95
Filing							
Prints IRS-approved forms	■	■	■	■	■	■	■
Prints IRS replica forms	■	■	■	□	□	■	■
Supports dot matrix printers	■	■	■	■	■	■	■
Supports HP LaserJet printers	■	■	■	■	■	■	■
Supports PostScript printers	□	■ (Windows version only)	□	□	□	□	■ (Windows version only)
Supports electronic filing	■ (professional version only)	■	■	■	■	■ (professional version only)	■

N/A—Not applicable: The product does not have this feature

Personal Tax Preparation

FACT FILE

EasyTax

SoftKey Software Products Inc., 4800 N.
Federal Hwy., Bldg. D, Boca Raton, FL
33431; 800-377-6567, 407-367-0005;
fax, 407-367-1611

List price: \$79.95; state programs, \$29.95 each

Requires: 640K RAM, 2.5MB hard disk space, DOS 3.0 or later.

In short: EasyTax's Interview option isn't as strong as those in other packages, but its preparation, guidance, and advice features are top-notch.



ON READER SERVICE CARD

menu—electronic filing—will also help you get through the process of filing electronically.

EasyTax imports data from Dollars & Sense, Lotus 1-2-3, Managing Your Money, and Quicken.

Though EasyTax handled the lion's share of our sample scenarios well, we ran into a problem with Schedule SE (self-employment tax) using the early-bird edition. While the program calculated Schedule SE correctly, it carried the total tax over to line 25 on the 1040 when only half should have been entered there. The total should be entered on line 47 of the 1040, but it doubled the total there. Also, some of the forms in the early-bird edition asked for data from 1991 instead of 1992.

The EasyTax package offers a lot of bells and whistles, but its impressive list of features is more than just smoke and mirrors.

For taxpayers who want to understand what they're doing when they prepare their tax returns and who are willing to spend the time absorbing all the guidance and helpful tips offered by the program, it's a great choice. It may even take some of the dread out of tax time.

Parsons Technology Inc.

Personal Tax Edge

Parsons Technology's 1992 version of Personal Tax Edge contains significant improvements over last year's. It offers new ease-of-use features and data entry options, as well as more comprehensive tax-filing guidance and review options. It

supports many more forms, and its list price is a low \$49.

Previously, you had two options for transferring information about your income and expenses into Personal Tax Edge: Direct Forms Entry and Tax Interview. Parsons has added a third option this year. Tax Organizer—Personal Tax Edge's version of the shoebox/file cabinet function offered by other programs—provides an alternative to working your way through the tax form line by line.

Tax Organizer displays a list of tax statements (W-2's, 1099's, charitable contributions and interest income, and so forth) and receipts and payments. You select the ones that apply to you, and Personal Tax Edge takes you to an entry screen. You then fill out the designated fields on these forms, worksheets, or schedules and the program calculates them and transfers the information to the correct fields on the correct forms. Unfortunately, not all forms are supported here; for example, we were not able to find a place in Tax Organizer to enter an IRA contribution.



SOFT-EDGE INTERVIEW

The Interview option asks you a series of yes-or-no questions. When your answer indicates that a form, schedule, or line on the 1040 needs to be filled out, you'll see a dialog box that tells you whether you need to fill in just one field on the form or the entire form itself before returning to the interview. If you don't pay close attention to the transitional screens here, you may find yourself filling out unnecessary fields. This wouldn't be a problem if the interface were a little "smarter" and automatically moved the user to the next section of the interview.

All three data entry options use a similar user interface, making the program quite easy to understand and use. Forms look like their paper counterparts, and you can use either the keyboard or the mouse to issue commands. Often-used shortcut keys are explained at the bottom of the screen. Pull-

down menus at the top of the screen include File, Return, Tools, and Options. Buttons along the right side of the screen give you access to options such as the notepad (for attaching a note to an entry), the bookkeeper (to provide greater itemized detail for entries), and the XRef command (describes the link between the current field or form and others).

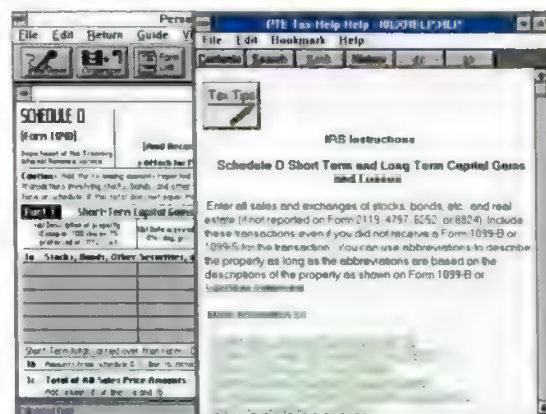
Help is available at several levels. IRS Instructions gives you brief explanations of tax law related to a particular entry. If the Tax Tips button is flashing, you can get more detailed guidance, and Topics lets you investigate related topics. Press-

SUITABILITY TO TASK				
Personal Tax Edge				
	POOR	FAIR	GOOD	EXCELLENT
Preparation	●	●	●	○
Guidance	●	●	●	○
Filing	●	●	●	○

ing F1 from most locations in Personal Tax Edge offers operational program help.

DOUBLE-CHECK

When you think your return is complete, you have several options for checking your work. The Audit feature searches the whole return for things such as incomplete fields, FICA or Medicare tax that looks unreasonably high, and any other input that looks questionable. Tax Saver Tips (more than 300 ideas) should be used before the end of the tax year, since this feature spells out strategies you could implement before the new year to save tax dollars. Tax-Saving Suggestions analyzes your 1992 tax data and offers post-



The DOS version of Personal Tax Edge clearly displays the Help tools available during every step of the program.

January 1 suggestions for paring down your tax bill even more. You can also compare your return with U.S. averages and with your return from the prior year.

Personal Tax Edge incorporates several improvements in its 1992 version. The "what if" scenarios now include a comparison of joint versus separate filing

for married couples. Six forms—1116, 2555, 4835, 4952, 6252, and 8582—and Schedule K-1 have been added. The new Estimated Flag lets you mark a value as estimated; when you run an audit, you get a reminder to complete flagged forms. And you can now import financial data from the 1991 edition of Personal Tax

Edge and compare last year's return with this year's to see if you're paying more money than in your previous return.

TAXPERTS

Users with more advanced returns will appreciate the enhancements made to the depreciation calculator; it now sup-

■ A Spreadsheet Tax Solution

by Kathy Yakal

Okay, so you're a power spreadsheet user and you don't want to learn a whole new program just for tax preparation.

Intex Solutions offers a solution that may be right for you. Tax Solver (\$79.95) is a set of templates that can be used with Lotus 1-2-3, Microsoft Excel, or Symphony for income tax preparation. It's not as easy to use as some of the products we review here, and it doesn't offer as much guidance or tax law reference information as some other programs, but the early-bird edition we looked at had some pluses the others didn't.

NO TALK

There's no Interview option for data entry in Tax Solver. You follow pretty much the standard line-by-line data entry procedure available in every dedicated tax package we looked at: Select the forms you want to use, open them, and fill them out in any order you choose. You tab around the documents the same way you'd move around any spreadsheet; figures you enter appear in the data window at the top of the screen and are transferred into the appropriate fields. All necessary calculations are handled automatically, as are all required transfers of data to other forms or schedules.

Tax Solver is essentially a template with built-in macros. You enter commands by using function keys and keystroke combinations. For example, in the Excel version, F9 recalculates the return and Ctrl-P prints.

Under Excel 4.0, Tax Solver does add a short Tax drop-down menu to

the main spreadsheet's menu bar. Options here give you quick access to macros for functions such as working in whole dollars without pennies; changing the page setup and row heights; and opening, saving, and printing forms. The Help command is located here too, but it only offers a few brief tips on program operation.

SOME HELP—NOT A LOT

While Tax Solver provides more guidance than some of the standalone packages we looked at, it's still pretty sketchy.

IRS instructions for filling out the 1040 are available on-line. Beyond that, you can run the program's Tax Return Checklist, a list of questions, such as "Did you deduct for an IRA?," that relate to the major categories in the Form 1040 and supporting schedules. The form's instructions suggest that you review any field that has a no answer. This isn't a very thorough review option, though it may alert you to questions you've neglected to answer.

Tax Solver also generates a short Warning Audit Comparison, which compares your medical expenses, taxes, interest, and contributions to national averages for your adjusted gross income level.

THE GOOD STUFF

Spreadsheets are great for "what if" analysis, and Tax Solver brings this power to tax planning: You can plug in different numbers and instantly see how the outcome (in this case, your tax obligation) is affected. If you're an Excel user, you can harness the power of that program's scenario manager to

help analyze your Tax Solver data.

Further, templates for 147 official IRS forms and schedules are included in the program—a far more generous list than those provided by even the best dedicated packages we looked at. Printed output from Tax Solver was top-notch, easily rivaling the other Microsoft Windows-based standalone tax packages. The forms we printed, both in Excel (using TrueType) and in 1-2-3 (using WYSIWYG), looked as good as or better than the official IRS forms.

State forms are available for California, Massachusetts, and New York, for \$39.95 each.

Technical support for Tax Solver is free, and Intex Solutions' technical support lines are open seven days a week during tax season. Intex Solutions also sells a business module for Tax Solver, which includes four different form categories: 1041 Fiduciary, 1065 Partnership, 1120 Corporation, and 1120 S-Corporation.

Tax Solver's cost puts it at the high end of the price range for even the best standalone tax preparation programs we reviewed here, while it lacks any significant guidance and interpretation of IRS tax law. But for confident tax preparers who don't need a lot of hand-holding, Tax Solver offers twice as many tax forms as the standalone packages and the advantage of a working format that is already familiar to spreadsheet users. □

Tax Solver

Intex Solutions Inc., 35 Highland Circle, Needham, MA 02194; 617-449-6222; fax, 617-444-2318.

List price: \$79.95.

Circle 469 on reader service card

ports listed property, gain or loss on disposal, and Alternative Minimum Tax computation.

Because the program requires so much memory (at least 640K), you may get an occasional message telling you you're out of memory. Sometimes this will keep you from opening a dialog box that contains instructions or tax tips or from opening all the forms you need. In the latter case (which only occurred when we used the Interview option), a message in a dialog box reminds you to go back in and fill out the missing forms manually. A soon-to-be-released Windows version should overcome this memory problem.

Personal Tax Edge is a solid program from a reliable publisher; it calculated our scenarios well, and its operations were well documented enough that learning time was minimal. And considering its low list price of \$49 Personal Tax Edge offers tremendous bang for the buck.

Parsons is introducing a new Windows version of its tax program this year. At the time this article was written, we'd only seen an early beta, but Personal Tax Edge veterans who use Windows will be pleased; Parsons has taken the same basic feature set as the one in the new 1992 DOS product and built it in a user environment that takes advantage of Windows' power. Though we didn't spot any new features, the interactivity and slick operation offered by Windows make the program state-of-the-art.

► FACT FILE

Personal Tax Edge

*Parsons Technology Inc., One Parsons Dr.,
P.O. Box 100, Hiawatha, IA 52233-0100;
800-223-6925, 319-395-9626; fax, 319-395-0217*

List price: \$49, state programs, \$49 each
Requires: 640K RAM, 2MB hard disk space, DOS 2.11 or later

In short: With the addition of Tax Organizer and the improvements made to the program's tax interpretation and guidance, Parsons Technology's Personal Tax Edge pulls a step closer to the leaders in this field. The product offers a strong combination of features and is easy to master quickly; it is a good, safe buy. A Microsoft Windows version should be out now that offers the same feature set in a graphical environment

 ON READER SERVICE CARD

Digital Frontier Corp.

TaxBreak

TaxBreak (\$39.95) is by far the most bare-bones fill-in-the-blank program we looked at. There's no Interview option to guide you through the program, not even a brief questionnaire to help you determine which forms you need to fill out. If you don't know what you're doing, you won't get any guidance from the program. This product would be best used by someone with an extremely uncomplicated return, or by someone who understands tax law very well.

According to the vendor, TaxBreak's Help feature—which was not completely operational in the early version that we looked at for this article—will offer context-sensitive IRS instructions scanned directly from the originals.



IT WON'T BREAK...

TaxBreak, though, is perfectly capable of preparing and printing simple returns. A menu bar running across the top of the screen lists your program options in logical order. You fill out the taxpayer information screen, then select the forms and schedules you need.

When you open a form in TaxBreak, you get a drop-down menu listing your form options: Fill Up, Print, View, Import (from the previous year's version only), Override, and Escape. Exiting the current form by selecting the Escape menu item is the only way to move from one document to another, since the program has no linking capabilities and only beeps when you press the Esc key. In fact, you have to scroll to the bottom of a menu and select Escape to even look at another menu.

TaxBreak doesn't support the mouse; you navigate around the program using the cursor and function keys.

KEEPING TRACK

Worksheets and schedules keep separate running tallies for the taxpayer, the taxpayer's

► FACT FILE

TaxBreak

*Digital Frontier Corp., P.O. Box 173,
Westford, MA 01886; 508-692-0453;
fax, 508-392-9410*

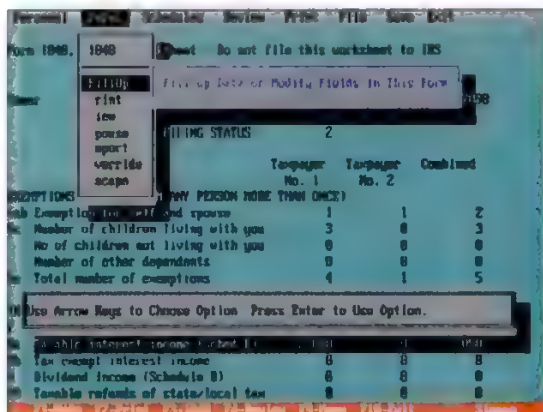
List price: \$39.95
Requires: 640K RAM, 512K hard disk space, DOS 2.0 or later.

In short: TaxBreak, from Digital Frontier Corp., is not recommended for the novice; the user interface can be frustrating, and tax guidance and interpretation are nonexistent. The final release should feature context-sensitive IRS instructions. Unless you have a very simple return or you're an expert at tax preparation, you should probably look beyond TaxBreak. The idea behind the design of this product was to give users the most forms at the lowest price. That, at least, they've accomplished

 ON READER SERVICE CARD

spouse, and the combined total. The program calculates automatically, but there's no built-in calculator. You can access a notepad—a blank, calculating worksheet—from most working screens, and, if you choose the option, your totals will automatically carry over to the form when you exit it.

Some idiosyncrasies in the user interface may slow you down a little. Blank fields contain default characters you either have to delete or type over. If you make a mistake entering data in a field that has limited space for your answer, you lose that character's space, and you have to hit the Insert key to get back all the blank fields. And in the version we tested, we had occasional problems scrolling through documents. On one trip



TaxBreak's menu bar provides pull-down lists of options available for each successive step of tax preparation.



GUARANTEED

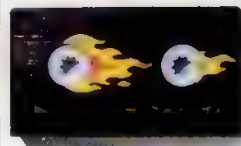
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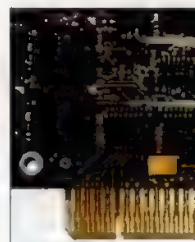
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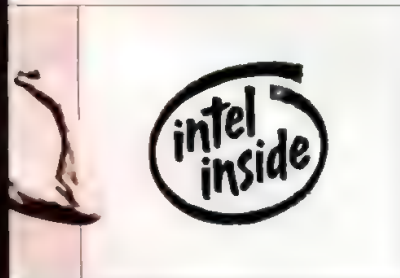
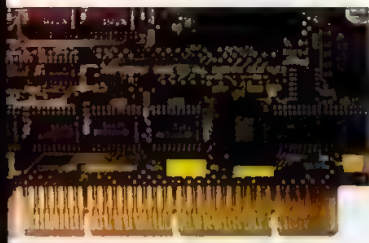
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SUITABILITY TO TASK

TaxBreak

	POOR	FAIR	GOOD	EXCELLENT
Preparation	☒	☐	☐	☐
Guidance	☒	☐	☐	☐
Filing	☒	☒	☐	☐

through the Schedule A, we couldn't scroll down to the bottom; we kept getting popped back to the top of the screen.

GIVE IT A BREAK

To its credit, TaxBreak does jump back to the previous menu automatically after you have filled in a form, which is something that some of the better programs would not do.

An electronic filing option, which was not operational at the time that we tested the program, is expected to be included in the final version. And for users who want to print their forms, the TaxBreak program now supports any dot matrix or

laser printer that can print a standard typeface, such as Courier in 12-point 10-pitch format, and also produces IRS-approved forms.

TaxBreak's designers wanted to provide the greatest number of forms at the lowest possible cost to the user. But unless you're absolutely sure about what goes where on your tax return, and you can live with an idiosyncratic user interface, you might not want to consider this program.

■ Money Managers Aid Tax Prep

by Kathy Yakal

Keeping detailed financial records throughout the year can save an enormous amount of time and trouble at tax time. It can help save you money, too—especially if you're self-employed and can deduct a lot of business expenses. For example, if you estimate your next year's tax liability in the fall based on these running tallies and find that your income is high and your expenses low, you could start an IRA, buy needed business equipment, or increase your quarterly estimated payment to avoid excessive taxes or penalties.

Although you can, of course, do this on paper, today's most popular personal finance packages make such tracking easy by building in reporting features for income and expense categories. At the end of the year, you press a few buttons, and you've got lists and totals for all those receipts and checks and scribbled notes you used to collect in shoeboxes, drawers, or envelopes.

If you've chosen a personal finance package and tax program that are compatible (see the features table for details), importing all pertinent data directly into your tax package is simply a matter of following the instructions provided by both applications.

QUICK TAX

Quicken (for DOS and Windows), from Intuit (800-624-8742), is set up beautifully for this task. When you write a check or enter a deposit in Quicken, you assign it to one of the

program's predefined expense or income categories. Every predefined category that includes income tax-related items is already assigned to the appropriate IRS form. (You can, of course, create and assign your own categories.)

New from Intuit is Quicken Companion (\$14.95), which includes a Tax Estimator that calculates your approximate tax obligation at any time of year and allows the comparison of multiple tax scenarios. Unfortunately, it doesn't read tax summary report data directly; you have to enter the numbers by hand.

MICRO MONEY MANAGEMENT

Microsoft Corp.'s (800-426-9400) Microsoft Money has tax preparation features much like Quicken's. Money 2.0's predefined income and expense categories are already assigned to the appropriate IRS form or schedule, though, as with Quicken, you'll have to designate the correct form or schedule for categories or subcategories you add. Money prints two different kinds of reports for this purpose. The Tax Report tallies all tax-related transactions. The Tax Form Report tallies all related entries by tax form and line number.

TAX MANAGER

While not a full-blown tax preparation product, Managing Your Money (MYM), from MECA Software (800-288-6322), goes further than any other money management package in helping you prepare for April 15. The key is the integration of MYM's basic rec-

ord-keeping with the built-in Tax Estimator feature.

Like Money and Quicken, MYM assigns your income and expense categories to the appropriate IRS forms and schedules for year-end reporting. But if you want to take your tax temperature at any point during the year, you simply select Form 1040 from the program's Tax menu and press F7. This gives you an instant estimate of your federal income tax obligation.

IMPORT DIVIDEND

MECA's Andrew Tobias' TaxCut has the most generous parameters for importing tax data; the 1992 edition accepts financial data directly from CheckFree, Fidelity On-Line Xpress, Managing Your Money, Money, Quicken, and TurboTax for DOS (1991). Final import procedures had not been implemented in the early versions of the tax programs we looked at, so we weren't able to test them.

Generally, though, you prepare your financial files for export to a tax package the same way you'd prepare them for export to any other kind of software: You set up parameters for the data you want to send (usually by compiling a tax report) and specify a file format to save it in. To minimize compatibility problems, most major financial management programs now support the standard Tax Exchange Format (TXF), a specialized ASCII file that can be imported by the most popular tax programs. □

Personal Tax Preparation

MECA Software Inc.

Andrew Tobias' TaxCut for DOS

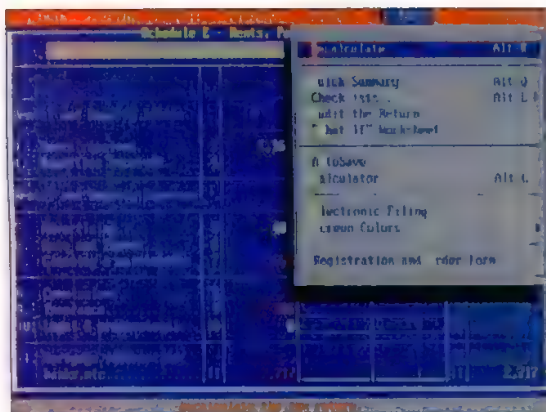
Andrew Tobias' TaxCut for Windows

Andrew Tobias' TaxCut has long had a loyal following of users, thanks to its easy operation, witty on-line comments, thorough documentation of tax law, layers of advice and guidance in the actual preparation of a tax return, and the solid standing of its publisher. Its fine reputation has been well earned, though its many improvements don't compare with the quantum leaps made in the 1992 edition of TurboTax, particularly in the overall look and feel of the user interface, a critical element of tax preparation software.

TaxCut comes in both DOS and Microsoft Windows versions. Its core features are basically the same, though the Windows edition—simply because of the more sophisticated operating environment—may offer a better framework for the onerous task of tax preparation.

DEEP TAXES

Both versions support more than 85 forms, schedules, and worksheets. Both



The Tools menu in Andrew Tobias' TaxCut for DOS contains some of the program options available.

give you the option of entering data directly on the forms or answering questions in the Interview format. If you're a novice computer user or at all unsure of your abilities to understand the IRS

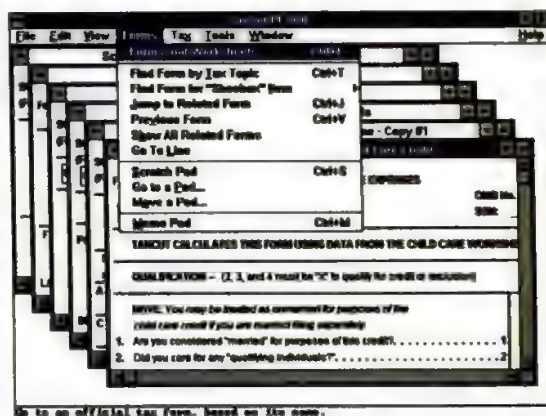
forms and schedules well enough to fill them out accurately, it's advisable to use the Interview feature. As opposed to the direct forms entry option, where you simply work your way through the 1040, jumping to other supporting forms and schedules where indicated, the Interview feature does just as it implies. It asks you direct questions—in plain, understandable English—about your income and expenses. It translates your answers, does all the calculations required, asks you for more details when necessary, and deposits the answers right where they belong on the tax forms.

No matter which approach you choose, when you come across questions

SUITABILITY TO TASK				
	POOR	FAIR	GOOD	EXCELLENT
Preparation	●	●	●	○
Guidance	●	●	●	●
Filing	●	●	●	●

that you're not confident answering right off the bat, you can request further explanations and IRS instructions. TaxCut is more cautious than most other tax programs; it warns you when you might want to consult a professional before entering a particular response. On difficult issues, the program tries to give gentle, understandable guidance, saying "Most taxpayers will say. . ."

TaxCut excels not only at helping you prepare your return as painlessly and as quickly as possible, but also in helping you check your work, explore tax-saving opportunities, and tie up any loose ends. It lets you consider a wide range of "what if" scenarios, including filing jointly or separately if you're married. Its handy Shoebox feature tells you exactly where any element of your finances belongs on the tax forms. You can run an audit on your return that will alert you to any responses the IRS might find incomplete or other-



The Forms menu in Andrew Tobias' TaxCut for Windows lists options for finding and moving to other documents.

wise objectionable. And you can compare your deductions, taxes, and other expenses with averages compiled from returns filed by other people around the country at your AGI (adjusted gross income) level.

A NEW MECA

MECA has improved an already excellent program with several new features and capabilities in the 1992 edition. The Interview feature is more complete than ever, offering even more tax advice than before. Audit flags—warnings about inconsistencies or missing information anywhere in your return—evaluate more thoroughly. More forms and worksheets are supported, bringing the total to more than 85. TaxCut's already-generous im-

FACT FILE

Andrew Tobias' TaxCut for DOS

Andrew Tobias' TaxCut for Windows

MECA Software Inc., 55 Walls Dr.,
Fairfield, CT 06430-0912; 800-288-6322,
203-256-5000; fax, 203-255-6300

List price: \$79.95 each, state programs, \$24.95 each.

Requires: DOS version: 640K RAM, 4MB hard disk space, DOS 3.3 or later. Microsoft Windows version: 2MB RAM, 5MB hard disk space, DOS 3.3 or later, Windows 3.1

In short: Andrew Tobias' TaxCut has been a favorite for years because it's understandable, thorough, and reliable. Considering that this year's version is even better, its popularity isn't likely to be threatened.

ON READER SERVICE CARD

Personal Tax Preparation

port capabilities have been enhanced; you can import data from CheckFree, Fidelity On-Line Xpress, Managing Your Money, Microsoft Money, Quicken, TurboTax for DOS, and any program that supports the standard Tax Exchange Format (TXF).

In addition, the 1992 edition now incorporates communication software re-

quired for electronic filing; it supports the TrueType fonts in Windows 3.1; its Describe Calculations feature explains how a given entry was calculated; and its AutoSave prompts you to save your work at certain intervals. Also, the 1992 edition of TaxCut offers more interactivity with its state versions.

MECA is so confident of the TaxCut

program's accuracy that the company offers to pay any penalty incurred if the program miscalculates anything.

TAX CUTS

Fine as it is, TaxCut is not without warts. If you get partway through the program using the direct forms entry option and need more help, you can't just choose to

■ Tax Alternatives to Consider

by Kathy Yakal

Most PC users who use software to help prepare their taxes probably use one of the mainstream packages reviewed in this roundup. There are, however, some other options that you might want to consider before deciding. Here are some of them.

HEIZER TAX SERIES

Heizer Software (800-888-7667) sells tax preparation templates—mostly designed for professionals—for use with Microsoft Excel 3.0 and 4.0.

The Heizer Tax Series does contain two packages targeted at the general consumer market, however. The 1040 Individual package (\$49) includes 1040 Forms and over 50 supporting schedules and worksheets, as well as an audit check. The 1040 Individual Tax Planner helps you do long-range (four-year) tax planning. This package requires Excel 4.0 and retails for \$20. Several state forms are also available for \$19 each.

KIPLINGER'S TAXCUT

Kiplinger Washington Editors, publishers of financial-advice periodicals such as the *Kiplinger Washington Letter*, are adding their expertise to a new version of Andrew Tobias' TaxCut, from MECA Software.

This new program combines the ease of use and sound guidance offered by MECA's software product with the tax advice and expertise that Kiplinger has been providing for nearly 70 years. It won't be available in stores, but you can order it by calling 800-365-1546.

LASERTAX

Datamax, a Canadian company that has been designing tax software for the Commodore Amiga since 1986, is moving into the PC market with a new Windows-based tax preparation and planning product. LaserTax is a two-part program, consisting of a 50-form tax preparation product and Tax Forms on CD, a comprehensive IRS-form library

ChipSoft's Personal Tax Planner is designed to help the growing ranks of self-employed people who are required to file quarterly income taxes.

from which you can display or print documents.

Every IRS form, instruction, and publication available is included on the CD-ROM disk. Documents are stored in compressed Windows .BMP format on a 600MB CD-ROM and can be displayed as 256-gray-scale images at 800-by-600 Super VGA resolution on your screen. The program even lets you add voice notes to tax returns. You can prepare your tax returns and print them out as perfect replicas of the IRS forms (no HP font cartridges or PostScript required) or fax them to Nelco for electronic filing.

Best of all, the price is only \$49. To order, call 800-859-8500.

PERSONAL TAX PLANNER

ChipSoft (619-453-8722) is introducing a new product this year, designed to help the growing ranks of self-employed people who are required to file quarterly income taxes. DOS and Windows versions of Personal Tax Planner were designed to help taxpayers comply with the Tax Extension Act of 1991. The program computes modified adjusted gross income and calculates an adjusted estimated tax-payment rate and schedule. It has guidance and help features similar to those found in TurboTax and retails for \$49.95.

TAX PREPARER

HowardSoft (619-454-0121) has been designing tax preparation software since 1979. The company's PC version of Tax Preparer has many of the same features and capabilities the programs reviewed here have (processing of IRS forms and schedules, on-line guidance, "what if" analyses, printing or electronic filing, and so forth), but the cost is a lot higher: \$295 for the first year, \$99 thereafter annually.

Its screens are not nearly as elegant as those found on the less expensive products represented here, and it's targeted at a more sophisticated audience than the packages we looked at. Still, the cost is lower than many of the more powerful products that are designed specifically for tax preparation professionals.

Tax Preparer runs under GW-BASIC, which comes in every version of DOS up to, but not including, 5.0. DOS 5.0 users will have to get a copy of GW-BASIC to use the program. □

THE OLD WAY



THE TaxCut WAY!



This Year, Harness the Power of Your Computer to Complete Your Tax Return.

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This year, team up with Andrew Tobias' TaxCut and your computer to complete your tax return. You'll secure the skill of America's best tax professionals. Plus, use your computer's power to save time and money. And, you'll understand your taxes as never before. With TaxCut® Software, filing your own tax return is a simple two-step process:

1. Key in answers to the questions your computer asks.
2. Print and file!

How TaxCut Works

You start by selecting the Interview, Shoebox, or the Direct-to-Forms method.

The Interview. Answer a few simple Yes-or-No questions right on your computer screen. Next, from the thousands of questions in its database, TaxCut selects just those questions it needs to correctly fill out your return, including which forms you should file. You key in your answers, TaxCut shows your completed return on your screen, then prints IRS-approved forms ready to file, on plain paper. Or, file electronically and get your refund in as little as two weeks!

The Shoebox. Pick up any receipt from your pile of records. Use the scroll-box that TaxCut shows you to identify the type of record. Key in the figure. TaxCut decides where it should go on your return, then does all the calculations.

Direct to Forms. Simply enter the numbers, and let TaxCut automatically carry the amounts to each relevant form. TaxCut then does all the math.

Become Your Own Tax Expert Instantly

TaxCut knows the entire Tax Code, so you don't have to. You access only what you need through the on-line Help key. Or, go straight to IRS instructions, if you prefer.

TaxCut Audits Your Return Before You File

TaxCut checks every figure as you complete your return. Then it compares your deductions with national averages. The program alerts you to anything that looks out of line, to reduce the risk of an IRS audit.

Guaranteed Accurate

TaxCut's Accuracy Guarantee: if the IRS makes you pay a penalty because of a miscalculation in TaxCut, MECA will pay that penalty for you.

Your Complete Tax Tool

TaxCut provides over 85 different IRS-approved forms and worksheets, from the most common to the obscure. You can also file the new IRS-preferred 1040PC form, which can speed your refund.

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System Requirements

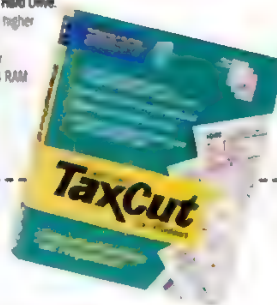
DOS: IBM PC/Compatible, 640K RAM, Hard Drive.

Windows: IBM PC/Compatible, 286 or higher

Hard Drive, Windows 3.1, 2MB RAM

Mac: Mac Plus, System 6.0.2 or higher

System 7 compatible, Hard Drive, 2MB RAM



☐ **YES!** Please reserve my copy of TaxCut for the 1992 tax year now (plus state editions indicated). You'll bill my credit card/cash my check today, send my Free Software (U.S. Atlas, for DOS and Windows buyers, and MacUSA™ for Macintosh buyers) and my Tax Planning Checklist.

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SOFTWARE
Personal Tax Preparation

pick up the Interview feature at the point you're at. You have to go back and start over (though the answers you've already supplied will remain filled in).

In the Windows version, you have to use a combination of the Shift and Tab keys to back up, or click on the desired field. While that's a common Windows convention that many programs use, it can be mighty irritating in an application such as tax preparation. TurboTax, on the other hand, allows you to back up by using the Arrow keys. And while TaxCut's user interface is overall superior to many of the products we looked at, its look and usability could be better.

Every field that requires offstage calculation forces you to override it to enter your own data. This too is standard procedure in most tax programs, but users who don't want to document every figure with a supporting worksheet might like the option to turn that feature off. It's a useful reminder—and a necessary one—when you're dealing with a field that the IRS requires a supporting form or schedule for, but the Jump-or-Override box ap-

pears every time the program determines that you should have backup documentation for your own records.

While even the best of these programs don't claim to be professional tax advisers, they claim comprehensiveness that falls short sometimes. We ran into this problem twice in testing scenarios: once when calculating the depreciation on a home computer and once when trying to figure an underpayment penalty. In both instances, TaxCut told us that the issue was too complex for it to guide us through. It said we could try to find our way on our own and suggested we get help from the IRS or obtain a particular IRS publication.

But these criticisms of TaxCut are minor when you look at the overall power of the program. Its plain-English approach to an extraordinarily complex process, its exceptional implementation of both the DOS and Windows user interfaces, and its thorough guidance and follow-up review features add up to a safe, solid, easy-to-use program. It minimizes frustration and actually adds some fun to

a rather unpleasant task.

At press time, MECA announced that several new features and enhancements would be a part of the final edition of TaxCut. Among the new features will be an Interview format that will walk you through processes it previously didn't cover; a Steps option to provide a list of the steps necessary to complete your return; and Tax Help Topics, which will give you random access to any part of the Interview process.

Financial Services Marketing Corp.

TaxPerfect Personal 1040

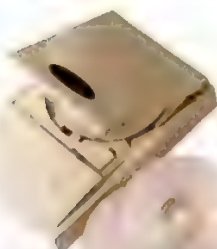
Each year, Financial Services Marketing Corp.—much like other tax software vendors—improves its product, the \$99 TaxPerfect Personal 1040. If this trend continues, the product may someday match the power and guidance of this market's premier products. Until then, most users should find satisfaction with TaxPerfect, but not much more.

TaxPerfect's user interface is some-

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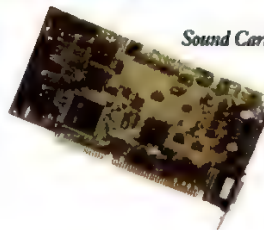


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SOFTWARE

Personal Tax Preparation



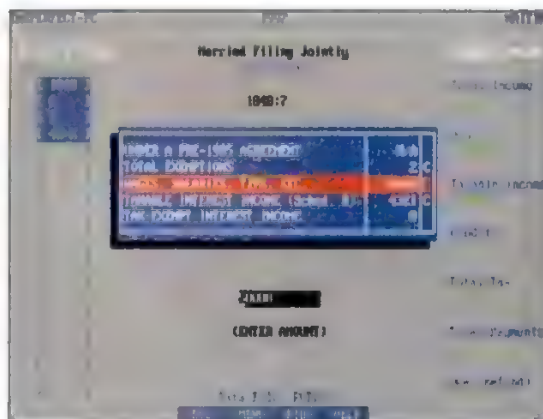
thing of a cross between the Interview option and the straight data entry method that is offered by other programs. There's a small window in the middle of the screen that contains a very long list of all the data required to prepare a tax return.

The program doesn't ask you questions as traditional Interviews do. It simply prompts you for information such as your (or spouse's) first name and middle initial; wages, salaries, tips, and so forth; and interest and dividend income. You type the correct answer in the box pro-

vided and hit Enter to scroll through the list of questions (there's no mouse support). Fields that the program automatically calculates are marked with the letter C. You'll have to override those fields if you want to enter a total manually without first filling out the required supporting schedules.

If a data field requires work on a supporting form or schedule, the name of that document appears in parentheses after the information prompt. Pull down the Forms menu and get the copy you need. At any point, you can view a print preview of the form you're working on (with your answers in the appropriate fields), but you can't enter data in this view.

The main screen also shows a running tally of the forms you've selected so far and a current summary of values, such as Adjusted Gross Income, taxable income, and credits and figures that continue to change as you enter more information. A



You work with TaxPerfect Personal 1040 by answering the scrolling list of questions in a dialog box on the main screen.

box at the top of the screen tells you what line from the 1040 Form corresponds to the prompts currently displayed.

SUITABILITY TO TASK				
TaxPerfect Personal 1040				
	POOR	FAIR	GOOD	EXCELLENT
Preparation	☒	☐	☐	☐
Guidance	☒	☐	☐	☐
Filing	☒	☒	☐	☐

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FACT FILE

TaxPerfect Personal 1040

Financial Services Marketing Corp., 500 N.
Dallas Bank Tower, 12900 Preston Rd.,
Dallas, TX 75230; 800-525-5611, 214-386-
6320; fax, 214-386-6323

List price: \$99.

Requires: 640K RAM, 1MB hard disk space, DOS 2.0
or later.

In short: TaxPerfect Personal 1040, from Financial Services Marketing Corp., has an unusual, sometimes clunky user interface that gives the user less navigational help than the best programs. There is no IRS instruction, but it contains just enough forms and guidance to satisfy novice and experienced users alike. This product is recommended for people who want a fairly comprehensive, no-nonsense tax program.



ON READER SERVICE CARD

are displayed, allowing you to scroll faster through the prompts. Tax Preparation Mode requires input at every appropriate field.

Two different help menus are provided. Pressing the Esc key brings up a menu bar across the top of the screen. It contains pull-down menus marked File, Tax Form, Print, Options, Color, Help, and Exit. The F10 key gives you program help; it tells you what each function key does and explains shortcuts for bypassing the main menu.

TAX ZAP

TaxPerfect offers an electronic filing option and prints IRS-approved substitute forms.

This product's tax guidance is fairly sketchy. The Data Chek feature—TaxPerfect's version of an Audit function—looks for and gives you a list of potential problems (such as additional forms that may be required and fields not filled out completely). The Override Tracking function on the Options menu tells you what data fields you overrode. Beyond that, there are no explanations of IRS instructions or suggestions for finding tax breaks—you're on your own.

While TaxPerfect offers the basic feature set required to prepare a fairly uncomplicated tax return and contains a forms list complete enough to handle more complicated returns, its user interface is clunky, requiring more keystrokes

than should be necessary. For example, every time you leave the main screen to work on a form and return to the 1040, you'll find yourself back at the top again, and you'll have to scroll through the entire list to get back to where you left off. Also, the program doesn't automatically recalculate every time you enter a new number; usually, you have to hit F1.

Further, some of the supporting worksheets lack the detail found in other programs. If you need to write up a Schedule D (Capital Gains & Losses), you're asked for only the cost of the asset you're selling and your original purchase price.

TaxPerfect contains just enough forms and guidance to satisfy novice and experienced users alike. It's not as slick as the best in this category, and it would rate a lot higher if it offered more thorough guidance, but it grows a little more sophisticated with each year's release.

ChipSoft Inc.

TurboTax for DOS

TurboTax for Windows

Market leader ChipSoft has come a long way since last year's versions of TurboTax. Both DOS and Microsoft Windows



versions have seen big changes, but the most stunning alteration was made to the DOS upgrade. Rather than using last year's "next logical step" approach to navigation around

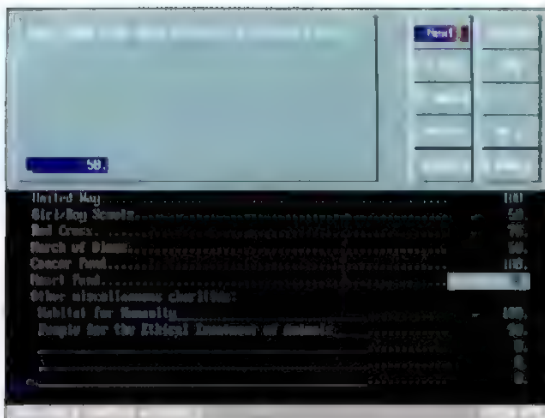
the required forms and schedules, the 1992 version's user interface has been revamped, offering instead the new Easy-Step System. Additionally, the DOS version was rebuilt so users could enjoy the benefits of a GUI (graphical user interface) while still operating within the DOS

SUITABILITY TO TASK

TurboTax for DOS, TurboTax for Windows

	POOR	FAIR	GOOD	EXCELLENT
Preparation	●	●	●	●
Guidance	●	●	●	●
Filing	●	●	●	●

Personal Tax Preparation



Using TurboTax for DOS's EasyStep, you answer questions in the dialog box and see your responses appear on the form below.

environment. The program's buttons, pull-down menus, and dialog boxes make it feel just like a Windows program.

Both versions offer two options for filling out your tax return: the EasyStep System Interview option and the classic straight data entry method. If you choose the Interview method, TurboTax asks you a series of simple, understandable questions about your finances to find out where you spent money in 1992 and where your money came from. If your answers indicate that you need to fill out a particular form or schedule, you'll be asked more specific questions to complete the document. TurboTax selects the required supporting forms—inserting numbers and making calculations as necessary—makes the necessary calculations,

and transfers totals to the correct lines on the 1040.

In both the DOS and Windows versions, the questions and spaces for your answers appear in a large box at the top of the screen. The form you're currently completing appears in the bottom half of the screen, so you can always see exactly where you are. If a more thorough explanation (either verbatim IRS instructions or TurboTax's interpretations) is required before you can answer a question, you can open a help dialog box. In the DOS version,

the box completely covers the form at the bottom of the screen. Under Windows, the box overlaps the Interview window. Both achieve a somewhat cluttered effect.

CHIPS OFF THE SAME BLOCK

ChipSoft has done an admirable job in designing a DOS user interface that looks and operates much like Windows. You

use the mouse or keyboard to select the buttons that control navigation (Next, Previous, Stop), offer help (Program Help, Tax Help, Summary), and help you document your work (Itemize, Note).

You can turn off EasyStep at any point and fill in forms directly. To get back to

ChipSoft has done an admirable job in designing a DOS user interface that looks and operates much like Windows.

EasyStep, pull down the Help menu, select EasyStep, and indicate where you want to start up again. If you don't complete your taxes in one session, save your work and you'll begin the next session right where you ended the last one.

The Windows EasyStep Interview works much the same way. It too uses the

PC FACT FILE

EDITORS' CHOICE

TurboTax for DOS

TurboTax for Windows

ChipSoft Inc., 6339 Nancy Ridge Dr., #103,
San Diego, CA 92121-3290; 619-453-8722;
fax, 800-756-1040

List price: \$79.95 each, state programs, \$49.95 each

Requires: DOS version, 640K RAM, 4MB hard disk space, DOS 3.0 or later. Microsoft Windows version 2MB RAM, 5MB hard disk space, DOS 3.0 or later, Windows 3.0 or later.

In short: Both versions of TurboTax are highly recommended. Novices will appreciate all the guidance available and will catch on to using it quickly. For experienced users, help is there if you need it and is unobtrusive if you don't.

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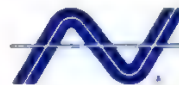
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Personal Tax Preparation

top portion of the screen for questions and answers, displaying a portion of the current form below. If you have all the necessary data before you start, you should be able to whiz right through it.

Unfortunately, design elements that enhance simplicity also work against TurboTax sometimes. In trying to make the product easier to use, unnecessary keystrokes were added to the process of listing itemized deductions, for example.

Still, it's a minor criticism when you hold it up to the overall impact of the interface. The designers of TurboTax for Windows should be applauded for putt-

***TurboTax is not a CPA, so
it can't advise you on
technical points of tax law.
But it does offer several
layers of on-line help.***

ing such care into designing an elegant, enjoyable user environment in a package that's typically used only once a year.

ANOTHER WAY

The File Cabinet offers a third option for completing your return. If you're used to dumping stacks of receipts and tax statements on your desk and spending hours sorting through them, this may be the ideal alternative for you. You can start anywhere in the stack and work your way through, selecting the type of statement from the list offered (medical expenses, W-2's, day-care costs, and so on). The File Cabinet will deposit the figures in the right places, on the appropriate forms.

TURBO HELP

TurboTax offers plenty of on-line assistance. It's not a CPA, so it can't advise you on technical points of tax law, but it offers several layers of help. Program help explains menu functions, shortcuts, and general operational commands. Tax Help contains context-sensitive explanations of line items and brief interpretations of IRS laws. IRS Instructions gives you the actual text of the IRS rules. Fields that require offstage calculations on supporting forms and schedules are traced

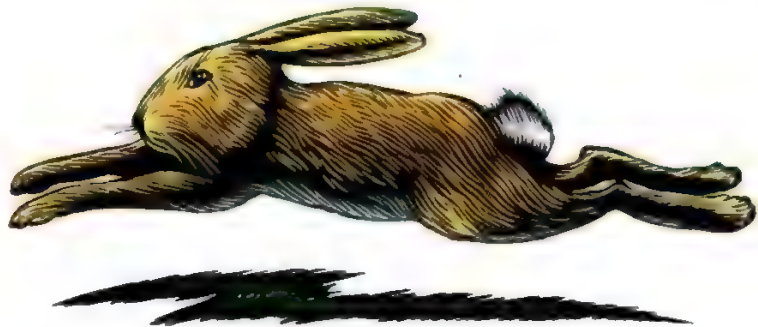
when you use the program's Cross-Reference button.

When you think you're done with your return, TurboTax provides another way to check your work. The Final Review function goes through all of your documents and displays a list of inconsistencies such as incomplete fields or numbers that look questionable. It points out responses that could trigger an IRS audit

and offers suggestions for lowering your tax debt.

Four new forms and 17 new (or redesigned) worksheets have been added, bringing the total to over 90 (over 100 in Windows). A more comprehensive Interview feature means you'll likely have to consult less with IRS instructions; but if you do, those regulations are more clearly explained. The new Progress Bar

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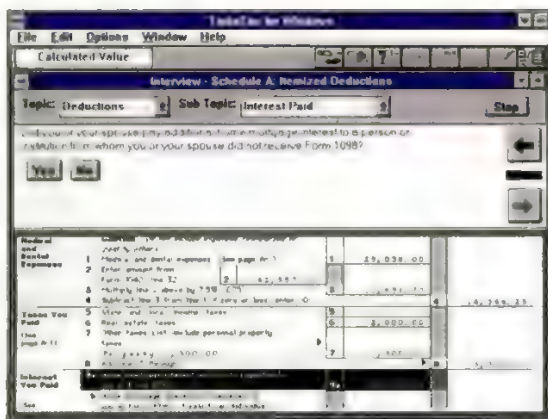
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When using the interview method in TurboTax for Windows, you answer questions in the dialog box at the top of the screen.

shows how far you've come in your tax return preparation and how much work you have left to do. Importing financial data from Quicken is also easier now, requiring 6 steps instead of 12.

GETTING EASIER

Redesigned menus and buttons simplify the user interfaces of both the EasyStep and the classic approaches. More tax-sav-

ing tips and audit flags in Final Review provide more feedback as you check your return for errors and omissions. Separate electronic filing software is no longer required, so the only charge for filing your return via modem to ChipSoft's processing center is the \$19.95 transmission/processing fee. And if you're charged a penalty that can be traced to a TurboTax error, ChipSoft will pay it for you.

Both versions of TurboTax provide two options for filing your return with the IRS. Both print IRS-approved forms on

most major dot matrix and laser printers. If you have an HP LaserJet Plus or compatible printer, you can install the soft fonts included with the program. If you use the Windows version with anything less than an HP LaserJet Series III, though, you'll have to disable Adobe Type Manager (if you use it) and set your graphics resolution at 75 dots per inch to get the forms to print right.

Financial data can be imported from CheckFree, Microsoft Money, Quicken, the 1991 version of TurboTax, or any .TXF file (Tax Exchange Format, the new standard file format for exchange of tax data among programs). The DOS ver-

Financial data can be imported from CheckFree, Microsoft Money, Quicken, and the 1991 version of TurboTax, or any .TXF file.

sion will import TurboTax for DOS 1991 data, and Quicken or .TXF files.

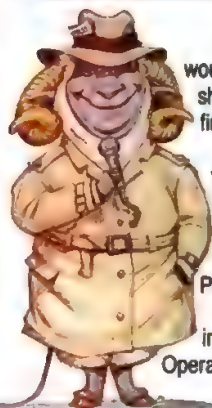
It's no surprise that TurboTax is the best-selling tax preparation product of its class, and, based on the improvements we've seen this year, it's likely to remain a favorite. □

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2-D Drafting: *Why Pay More?*

You can still spend thousands of dollars to turn a single PC into a computer aided-design (CAD) workstation. But before you spend all that money, you would be better advised to survey the field of less-costly alternatives. Today, many full-featured, PC-based CAD programs can be purchased for less than \$500. Moreover, the power of these less-expensive products frequently rivals—and in some cases exceeds—the power of products costing \$3,000 and more.

Despite the almost overwhelming power offered by today's PC CAD packages, most users are still only doing two-dimensional drafting. The more-expensive packages justify their expense by offering more sophisticated—but not necessarily crucial—capabilities such as three-dimensional solid modeling and photo-realistic rendering or binary compatibility with a mainframe or minicomputer version of a high-end program. So buyers looking for a drafting package will find that a CAD program's features, capabilities, and overall utility can no longer be

It used to be that obtaining a 2-D CAD package meant spending more for the software than for the hardware to run it on. That's not so anymore.

by Jeff Proise

► **IN THIS REVIEW**

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judged by cost alone; you might be as well served by a \$495 product such as Autodesk Retail Products' Generic CADD as by a package costing five times as much.

PICKING THE CONTENDERS

Before it was slated for inclusion, each package in this review had to meet a stringent set of criteria designed to separate the workhorses from the wannabees. We tested general 2-D drafting packages that supported extended or expanded memory, dimensioning, text annotation, hatching, E-size drawings, and command scripts (interpreted or compiled) or links to external programs. We also required that the program be able to utilize architectural and engineering symbol libraries, be able to interchange files in .DXF format, and carry a list price less than \$4,000. All of these are important attributes for CAD packages that will be used for professional drafting work, particularly if that work involves large drawings. Many of the products in this review sup-

port 3-D drafting and modeling also. No products were excluded for their 3-D capabilities, but 3-D support was not a requirement. (For a discussion of 3-D modeling capabilities, see the sidebar "A New Dimension.")

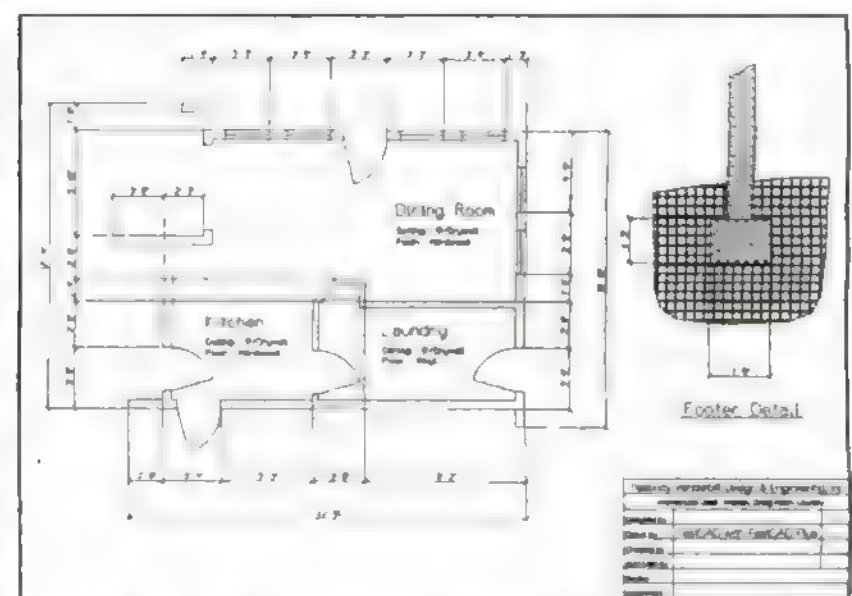
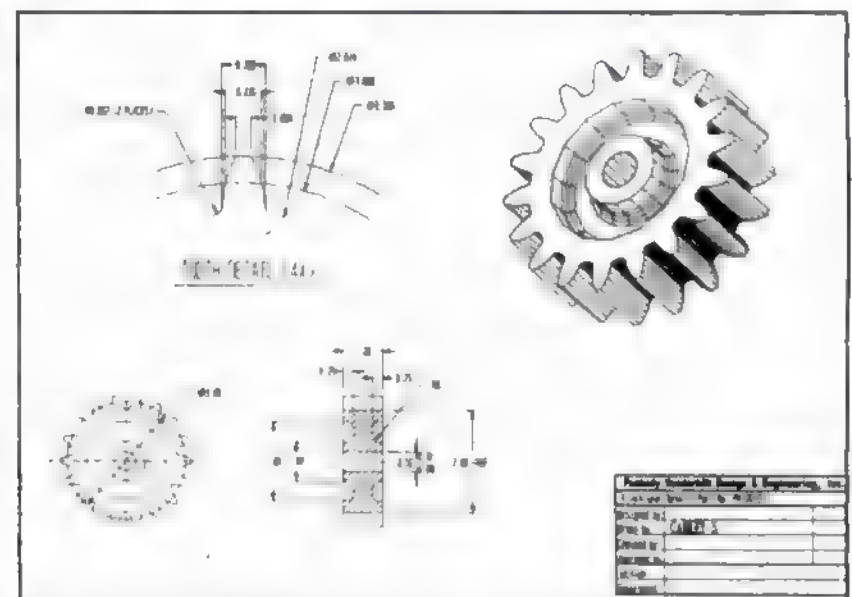
Several other products either did not meet our review criteria or did not ship in time for evaluation. Notable among these were Ashlar's Vellum, a highly touted Windows CAD offering that doesn't support command scripts; Interactive Design Consultant's Anvil-1000, which also lacks command-scripting capabilities; and Manufacturing and Consulting Services' Anvil-5000, which lists for \$8,000. We were unable to contact Cascade Graphics Systems for Cas-CAD III. Automated Methods' Ultimate CAD for Windows, Interactive CAD Systems' ProCAD, and Robo Systems International's RoboDraftsman either never arrived or arrived too late for testing, and Farb Systems' FarbCAD didn't meet our tough criteria.

To put the products through their paces, each reviewer began by duplicating a mechanical drawing (Figure 1) and an architectural sketch (Figure 2). Both deceptively simple drawings were designed to expose weaknesses that marketing reps won't tell you about. For example, the mechanical drawing revealed that many CAD programs will only fillet between lines and not between arcs and curves. We asked reviewers to make certain modifications to the mechanical drawing, which included changing the gear's thickness and outer circumference.

To test a product's dexterity at han-

dling nongraphical data such as parts lists and window schedules, our reviewers attached data attributes to the doors and windows in the test floor plan and then later exported them to an ASCII-formatted data file. If a package claimed to be networkable or network-friendly, reviewers installed it on a NetWare 386 LAN. Among other things, they verified that the program's file-locking mechanism worked as advertised and that two users couldn't edit the same drawing at the same time.

Some of these products were designed



To test these packages we created a mechanical drawing (top) and an architectural sketch (bottom).

Our Contributors: JEFF PROSISE is a contributing editor of *PC Magazine* and the author of its Tutor column. JOSEPH DESPOSITO is a frequent contributor to *PC Magazine*. PAUL MURPHY is a partner in Singer-Murphy Associates, a New Jersey-based land-surveying firm, and a frequent contributor to *PC Magazine*. JON GABAY is a New York-based engineer with Dedicated Devices Corp. DR. JOEL N. ORR is chairman and principal consultant of Orr Associates Inc. of Virginia Beach, Virginia, as well as a founder and past president of the National Computer Graphics Association. WILL SCHLETER and ROD TAYLOR are mechanical engineers based in Knoxville, Tennessee. BRYAN M. WINTER is an architectural designer working out of New York City and Annapolis, Maryland. EVAN YARES is a consultant with Phoenix-based Design Automation Systems.

to serve a particular segment of the market—mechanical or architectural designers, for example—and were not intended to be used outside of a given discipline. Others were truly general-purpose products designed to meet a range of 2-D drafting needs. To make these market orientations more apparent, we rated each product in four Suitability to Task categories: facilities management and mechanical, architectural, and work-group drafting. (Circuit-board design software is another story altogether; for more information in this area, see the sidebar "High-Tech Design.")

GRAPHICS 2-D Drafting

THE PRICE IS RIGHT

Over the years, product prices in most categories of software have become relatively uniform. For example, market forces have assured that no company can charge \$2,000 for a spreadsheet or word-processing program and reasonably hope to survive. Such market forces are foreign to the CAD marketplace, which continues to support two pricing tiers. On the one hand, you have low-end products such as EasyCAD 2 and Generic CADD, which sell for \$199 and \$495, respectively; at the high end, you have programs such as AutoCAD and MicroStation, which sell for more than \$3,000 apiece.

This is partly because CAD is still something of a specialty market, and specialty markets support diverse price-points. Similarly, CAD programs have traditionally been sold through the dealer channel, with concomitantly high prices; as products have entered the retail channel, prices have dropped because of competitive pressures. Hardware locks, called *dongles* (which attach to your serial or parallel port), are an unwelcome form of copy protection and represent another vestigial trait of dealer-channel products. Not only are they an annoyance, but they add an extra variable for compatibility. For instance, Intergraph Corp. admits that for MicroStation to work, your printer must be turned on while plugged into the parallel-port dongle. Drawbase 2000 and the two Cad-vance products also use these devices.

Another reason behind the market's ability to support a two-tier pricing structure can be found in the fact that the \$3,500 you pay for AutoCAD buys you an incredibly feature-packed program that supports multiple platforms and virtually every peripheral under the sun and is itself supported by a robust market for third-party add-ons.

The name of the game in selecting CAD software is to match the needs of the job to the capabilities of the software and to do your research well. Many of the under-\$500 packages come with nasty little gotchas that make intensive drafting work difficult. For example, a package may only hatch areas bounded by line segments (trouble for hatching around a fillet or an arc), or it might treat dimensions as collections of lines and numbers instead of as associative entities.

Suitability to Task: 2-D Drafting Software

A CAD program should integrate all the tools you need for common drafting tasks into a product that lets you work quickly and efficiently. These Suitability to Task ratings compare CAD programs on their ability to handle the most common 2-D drafting and facilities management tasks.

While a few programs excel at a multitude of CAD tasks, most of the products have strengths in one or two specific areas.

To score high on **architectural drafting**, a program should let you draw double lines and easily clean up their intersections, work in units of feet and inches, and manipulate symbols flexibly. Programs with strong capabilities in this area may support variable snap grids and have strong associative dimensioning capabilities as well as robust file interchange capabilities. Good text handling facilitates the production of polished-looking designs. Finally, speed and ease of use, which determine the user's productivity, play crucial roles in a package's usability.

To score high on **mechanical drafting**, a product has to offer a variety of associative dimensioning styles, including radial and diametral; and be able to cross-hatch within complex boundaries. It also has to support a wide selection of geometric entities and ways to manipulate them, a variety of snap types, strong file interchange capabilities, and flexible symbol handling. Associative detailing is a plus. Good text-handling features, including a built-in text

editor, facilitate the production of polished-looking designs. Again, speed and ease of use are crucial considerations for productivity.

Workgroup drafting ratings are based on our evaluations of how well each package works in a networked environment; this reflects how effectively the product resolves file contentions among users and how well it facilitates joint production of a drawing. Multiuser licensing policies and client/server or distributed computing support are big pluses.

The ease of creating, editing, and extracting data attributes, such as parts lists or bills of materials, is the overriding factor in determining a package's suitability for **facilities management** (or data management). Packages that can automatically update a drawing based on changes in the database get extra credit; for Windows packages, DDE support for data exchange may be a suitable equivalent. Since many facilities managers are not CAD experts, ease of use is of paramount importance in this context.

But sometimes even the high-end packages contain unpleasant surprises. The Cad-vance packages, which list for \$1,995, won't fillet between a line and an arc and will only trim drawing entities to their intersections with lines. Trimming a series of horizontal and vertical grid lines to their intersection with a circle is twice as much work in Cad-vance as it is in AutoCAD, which will use just about any entity type as a trim boundary. Nor do they support associative dimensioning, a feature universally supported by even the least-expensive packages.

Still, it would be a mistake to rule out any of the packages reviewed here based on price alone. Generic CADD remains one of the best 2-D drafting packages on the market in any price range. Design-

SUITABILITY TO TASK	
Product Name	
Architectural drafting	● ○ ○ ○
Mechanical drafting	● ● ○ ○
Workgroup drafting	● ● ● ○
Facilities management	● ● ● ●
Facilities management	N/A

N/A = Not applicable. The product does not perform this task.

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CAD 2D is a close second, and EasyCAD 2 boasts one of the best price-to-features ratios. On the high end, you can't go wrong with AutoCAD or MicroStation. And if you need the more high-powered tools that are generally offered as third-party solutions, you'll probably have better luck with one of the more expensive products; they tend to have broader third-party support (DesignCAD 2D is one notable exception, however).

Many companies have struck a compromise between the low end and the high end by supplying their drafting personnel with high-end packages such as AutoCAD and other users with low-end packages. Many vendors now offer two versions of their product: a full-blown version for professional drafting work

and a scaled-down version for drawing review and editing. Drawing files produced by the two versions are usually binary-compatible. By relying on .DXF files as a medium for transporting drawings between packages, you can choose two products from different vendors.

Nearly all CAD programs include a .DXF translator, but few are 100 percent accurate. In particular, text and dimensions usually require some touching up. If you standardize on two dissimilar CAD programs, expect to lose some time transporting drawings between them. Some of the packages reviewed here, including Generic CADD and Cadvance for Windows, can read native AutoCAD .DWG files. Expect to see more of them gain .DWG-import facilities in the future.

WINDOW OF OPPORTUNITY

The wide proliferation of inexpensive CAD programs isn't the only big news in the CAD market. There's more. An increasing number of vendors are supporting Microsoft Windows, leading long-time CAD users to ask: Is Windows a viable platform for CAD? Windows brings some interesting new possibilities to the table, such as the prospect of embedding a CAD drawing into a word-processing document using object linking and embedding (OLE), establishing live links between CAD drawings and spreadsheets with dynamic data exchange (DDE), and perhaps even doing away with the arcane interfaces that characterize so many of these products. But it is questionable whether Windows has the muscle to deliver the speed that is so essential to CAD users—or the appeal to entice them away from an environment they're familiar with.

The jury is still out on how much of an impact Windows will have on the CAD market. The three Windows CAD products reviewed here offer little that their DOS-based counterparts do not. OLE and DDE are attractive, but not everyone needs to link a CAD drawing to a spreadsheet. Furthermore, the Windows packages are hampered by sluggish performance times, rendering them unsuitable for large drawings.

Faster hardware and 32-bit processing environments such as Windows NT and OS/2 will eventually take care of this



EDITORS' CHOICE

- **AutoCAD, Release 12**
- **Generic CADD 6.0**
- **MicroStation PC**

When it comes to 2-D drafting, the price of your package may bear little relation to its quality; we've seen inexpensive packages that can take on jobs that can't be done by packages that cost ten times as much. The proof is Autodesk Retail Products'

Generic CADD 6.0, one of the best buys in the CAD market. For a modest \$495, you get a versatile product suitable for a wide variety of drafting tasks; it was also one of the speediest performers in the bunch we reviewed.

Of course, some jobs require the more advanced tools that can only be found in the more expensive products, such as MicroStation PC, Version 4.0.3, and AutoCAD, Release 12. MicroStation PC (\$3,450) is an exceptionally usable, powerful package, with such rare and exotic features as nonuniform rational b-splines. It is somewhat sluggish, however, especially when dealing with large drawing files, and its parallel-port lock is a nuisance. And though the \$3,500 AutoCAD, Release 12, won't win any awards for its interface or any races with its performance, its ability to take you all the way from design to execution of both 2-D and 3-D projects more than makes up for its drawbacks. For organizations that need both large numbers of inexpensive CAD stations

and a few higher-powered installations, the Generic CADD/AutoCAD combination is unbeatable.

DesignCAD 2D, Version 5.0; EasyCAD 2, Version 2.72; and Cadvance 4.02 deserve honorable mentions as well. For \$349, DesignCAD gives you a full-featured, relatively easy-to-use package especially suited for architectural drafting; if the \$150 list-price differential is more important to you than DesignCAD's sluggish performance, you won't go wrong with it. EasyCAD (\$199) is a great bargain. It has a few quirks and a more limited feature set than most of the other products, but it's still fast, fairly robust, and cheap. Cadvance 4.02 (\$1,995) isn't a drafting heavyweight; its lack of associative dimensioning is a glaring flaw, for example. But its exceptional facilities-management and workgroup capabilities make it a standout for users who need to perform those tasks. Cadvance 5.0 for Windows (\$1,995) is equally capable—but far more sluggish.

problem. A few vendors have plans to port their products to NT, but for now, NT itself is still only a coalescing gleam in Microsoft's eye. OS/2 has been out for a while, but the outlook for CAD packages under this operating system is mixed: Autodesk has discontinued its OS/2 version of AutoCAD, and only one company—IBM—continues to support the operating system. On the other hand, CadWare S.r.L's Pj2, which currently ships only in Europe but will soon arrive on our shores, fully supports OS/2's multithreading and interprocess communication capabilities.

For industrial-strength drafting work, DOS is still the environment of choice. For lesser jobs, such as sketching and reviewing, Windows will suffice. And if you must run CAD under Windows, give it all the processor power you can and consider investing in one of the market's many Windows accelerator video cards; the expense will be recouped in the time you save. PC CAD software continually changes and improves. Although many of the products still have far to go with respect to interface design, it is inarguable that we now have access to unprecedented drafting power on the desktop.

GRAPHICS

2-D Drafting

As matter of fact, if you choose to use any of the Windows products, you'll have to make major sacrifices for a few gains in usability. Drafix Windows CAD, Version 2.1, may have a well-designed interface, but it also has redraw problems, poor dimensioning, and slow performance. But general-purpose tools are not for everyone. Cadkey 5 and DataCAD, Version 4.06, are excellent products in their respective specialties: mechanical engineering and architectural drafting. Similarly, for 3-D modeling, SilverScreen Professional Edition, Version 3.13, proves an adept product at a reasonable price. It's not an efficient tool for 2-D drafting applications, however.

For the truly budget-constrained, TurboCAD, Version 3.0 (\$149.95), may seem like a great bargain, and it is—if you're willing to put up with an awkward interface and drawing size limitations. The higher-priced Drafix CAD Ultra, Version 4.2 (\$395), is a fundamentally good product, but it suffers from some dimensioning and interface quirks. And while FastCAD, Version 2.72, is a good, speedy performer, \$795 is a bit too much to pay given the competition.

Of the over-\$1,000 products, only the VersaCAD programs, VersaCAD/386, Version 7, and VersaCAD Design, Version 7, seem worth the outlay: poor memory management is the only drawback to this otherwise well-designed pair.

Autodesk Inc.

AutoCAD, Release 12

AutoCAD, Release 11, Extension for Windows

BY PAUL MURPHY

You need a darn good reason to spend the \$3,500 Autodesk exacts for AutoCAD, Release 12. The good news is that there are virtually infinite reasons for such an investment. Autodesk has once

again improved the performance and interface of this king of the CAD hill.

AutoCAD is to the architecture/engineering/construction community more than just a dominant product; it's an open-architected institution that has spawned more vertical-market add-on products than any other CAD software package. Thousands of specialty-design products, which are listed in the AutoCAD Resource Guide, utilize AutoCAD's AutoLISP programming language to transform AutoCAD into a customized tool for designing everything from printed circuit boards to textiles.

Even without such enhancement products, Autodesk has earned its position as an industry leader by constantly improving AutoCAD's core features and interface. With Release 12, Autodesk recognized that in order to foster product growth, it was necessary to abandon the 80286 chip, inevitably orphaning some users. Release 12 runs in 32-bit protected mode and demands a minimum 80386SX processor with an Intel math coprocessor (Weitek is not supported) and 8MB of RAM. It requires 26MB of free disk space for a full installation.

The rewards, however, are evident from start-up. While previous versions of AutoCAD started from a main menu, Release 12 goes directly to its revamped drawing interface. Menus have been rearranged more logically, and most functions can be accessed easily by mouse users. Most of the complicated setup and parameter input are now performed through logically arranged Windows-like dialog boxes. For instance, setting plotting/printing parameters in earlier versions was done through a lengthy, arcane question-and-answer session. This process has been replaced by a dialog that cuts the required time by two-thirds.

That is not to say that Autodesk has abandoned its past completely. The command line is still available, so experienced users will not have to relearn their working style. Though major changes

SUITABILITY TO TASK

AutoCAD, Release 12

	Arch	Eng	Arch	Eng
Architectural drafting	●	●	●	●
Mechanical drafting	●	●	●	●
Workgroup drafting	●	●	●	○
Facilities management	●	●	●	○

AutoCAD, Release 11, Extension for Windows

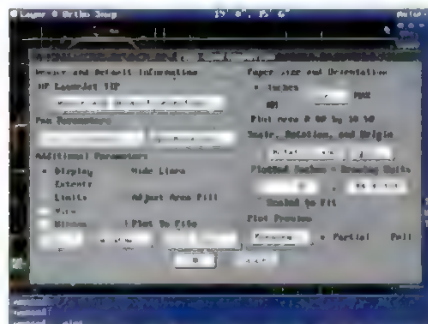
	Arch	Eng	Arch	Eng
Architectural drafting	●	●	●	○
Mechanical drafting	●	●	●	○
Workgroup drafting	●	●	●	○
Facilities management	●	●	●	○

have been made in the interface, they may not have gone far enough. A graphical user interface (GUI) without a graphical toolbox is still rather primitive.

The program was able to breeze through our test drawings without a hitch, topping the speed of earlier releases. There are a few minor gaps in its feature set, but many LISP routines are included on the free companion CD-ROM that allows AutoCAD to perform

extra functions, such as extended graphics and .DBF imports. This CD also contains demos of other Autodesk products, including Animator and 3D Studio. In Release 12, Autodesk has also incorporated shading and rendering functions directly into AutoCAD.

Moreover, this is not a static product. The programmability of AutoCAD's interface lets it become practically any application you can conceive. This flexibility is accomplished primarily through two pathways. First, AutoCAD employs the AutoLISP, a powerful high-level—but relatively easy to learn—programming language that lets users write macros to customize AutoCAD's menus and add



One of the many enhancements in AutoCAD, Release 12, is one-stop dialog boxes for entering parameters and settings.

■ Adding A New Dimension

by Dr. Joel N. Orr

Three-dimensional modeling has not attracted large numbers of CAD users, although its productivity benefits seem clear. With 3-D CAD, you need not extract 2-D views from a visual impression of a real or imagined object; you simply create the object. Then if you need 2-D views, the computer can automatically generate them, and they will be accurate and consistent with one another. What's more, the 3-D model will reflect any update in all of the views. For users, that means fewer errors and more consistency with reality.

The model also retains accuracy when moving from the design to the production process. And finally, 3-D models can be used to generate realistic images. This allows your clients to view and understand a design without having to decipher 2-D engineering drawings.

So why the seeming apathy? In a nutshell, most 3-D modeling requires too much computer power and is too hard to use and too different from what most designers learn in school. Furthermore, there are no standard techniques for 3-D design; each package has its own way of interacting with the 3-D model.

The high computing-power demands of 3-D have led some CAD vendors to offer "almost 3-D" features. For example, DesignCAD 3D uses z-buffering for rendering, rather than actual surfaces. Micro Cadam Plus makes it easy to produce isometric drawings, which are 2-D projections that illustrate what a 3-D object would look like from a particular angle.

TYPES OF 3-D

There are three methods for 3-D modeling: wireframe, surfaces, and solids. In wireframe 3-D, points, lines, and curves are defined in 3-D space. Most wireframe 3-D models are too visually crowded to be useful. Surface model-

ing lets you create more complex objects than wireframe modeling allows. Surfaces can be shaded, eliminating the visual complexity of the wireframe. But surface models are also hard to build; you have to mentally break the model down into its bounding surfaces and then construct them. Nor do surface models understand "inside" and "outside." The result can be geometrically ambiguous models—objects you can't construct in reality. The surface-modeling capabilities of the reviewed packages are not good enough for airplane and automobile design, for example,

*The last few years have
seen obstacles to 3-D
CAD melt away in the
face of new technologies,
and we will see more
3-D in the future.*

which demand easy creation, as well as manipulation of high-curvature surfaces.

Solid modeling is the least abstract and ambiguous method. If you can model it in solids, you can probably construct it. Solids "know" about interferences, so you cannot accidentally construct interpenetrating objects. If you want two solids to occupy the same space, you must override the modeling system. Making solid models is much easier than modeling with surfaces; even the basic systems available on PCs let you build things in reasonably intuitive ways.

PC-based solids packages still lag behind "feature-based" workstation products, which, for example, will let you drill a hole, grab it, and slide it around; with lesser packages, you must instead subtract a cylinder. AutoCAD,

Cadkey, and SilverScreen, which use a form of solid modeling known as constructive solid geometry (CSG), are the only reviewed packages that have solid modeling capabilities. The rest of the packages have only wireframe and surfaces and range in ease of learning from not easy to very hard.

PAVING THE WAY FOR 3-D

The last few years have seen many obstacles to 3-D melt away in the face of new technologies. High-power, low-cost workstations with special graphics processors have all but vanquished performance problems. Graphical user interfaces have made systems much easier to learn than ever before and have managed to hide the computer underpinnings of the 3-D system from the architectural or engineering professional. 3-D digitizers and cursor-control devices have made possible the development of new ways to approach the control of the 3-D model. Output technologies such as stereolithography and selective laser sintering close the loop for the 3-D designer by providing a physical model. Object-oriented programming and databases have provided tools to make the dynamic and relational characteristics of 3-D models as realistic and integral to the models as their geometry.

We will see more 3-D in future systems. Autodesk has licensed the ACIS modeling engine from Spatial Technology and is likely to employ it in some future version of AutoCAD. Other CAD companies have similar arrangements with Ricoh and other vendors of solid-modeling engines. High-speed networks and telecommunication links have facilitated the transmission of the large files that accompany 3-D designs. And with 100-million-instruction-per-second Pentium chips arriving soon, enough power will be available for 3-D to keep its promises. With the hardware available, the software can't be far behind. □



► FACT FILE

AutoCAD, Release 12

List price: \$3,500.

Requires: 386SX-based PC or better, math coprocessor, 8MB RAM, 11MB hard disk space, DOS 3.3 or later. 26MB hard disk space recommended. AutoCAD, Release 11, Extension for Windows.

AutoCAD, Release 11, Extension for Windows

List price: \$99.

Requires: AutoCAD, Release 11 or 12, 386SX-based PC or better, math coprocessor, 4MB RAM, 7MB hard disk space, DOS 3.3 or later, Windows 3.x, VGA or better display. 20MB hard disk space recommended.

In short: AutoCAD's large market presence is well deserved. Its interface may not be the most elegant, and it's not the fastest program around, but for sheer power, it can't be beat. The Windows extension, which provides a Windows interface to the DOS-based version of the product, runs even more slowly and is recommended only for true Windows devotees.

Autodesk Inc.,

2320 Marinship Way, Sausalito, CA 94965;

415-332-2344; fax: 415-331-8093



ON READER SERVICE CARD

functionality. The package ships with an array of AutoLISP routines; thousands more are available from third-party vendors.

Secondly, AutoCAD can be enhanced by applications developed using the AutoCAD Development System (ADS), a C programming environment that produces external applications loaded into AutoCAD by the AutoLISP interpreter. You can use either AutoLISP or ADS libraries to build custom dialog boxes for your custom application. Autodesk has also included a full ADS application in Release 12 called AutoCAD SQL Extension (ASE), which gives you access to external databases such as dBASE, Paradox, Oracle, and Informix.

With Release 12, AutoCAD has added full support for PostScript Level 1 and PostScript Level 2 output, including the ability to import and export Postscript files with scaling. In addition, most ADI device drivers that previously loaded as terminate-and-stay-resident programs (TSRs) can currently run in protected mode.

RUNNING UNDER WINDOWS

It is possible—with a bit of tweaking—to run AutoCAD as a full-screen DOS session under Windows; it makes more sense, however, to purchase the \$99 AutoCAD Windows extensions in order to make it a full-fledged Windows application. In its current incarnation, AutoCAD, Release 11, Extension for Windows is not a standalone application; it is a Windows interface that relies upon AutoCAD for DOS support files.

This isn't to say that AutoCAD for Windows isn't a friendlier environment to work in. Despite its Release 11 moniker, it performs equally well in tandem with Release 12, although it doesn't take advantage of some of the later package's new features, such as integrated rendering and shading and AutoCAD's Advanced Modeling Extension.

But in trying to maintain ties to the DOS version's interface, Autodesk has failed to fully exploit the very advantages that a real GUI might bring to a complex program such as AutoCAD. The status line has been replaced by a toolbar that contains layer and color information, as well as buttons to toggle snaps and ortho modes. But drawing tools are relegated to the drop-down menus, where they are graphically depicted, rather than made available on palette bars. And Autodesk's retention of the command line under Windows is a throw-

back rather than a necessity. Because the menus can't begin to reflect the full AutoCAD feature set, many commands *must* be entered at the command line.

AutoCAD for Windows was able to complete our test drawings with the same aplomb as its DOS sibling managed—but at a much slower pace; virtually every function works more slowly in Windows than it does in Release 12. In fact, there's little reason to recommend the Windows extensions to users of Release 12, whose own graphical interface—while lacking visual tools—feels much more robust.

Perhaps the best reason to consider

AutoCAD for Windows is its support for Windows dynamic data exchange (DDE), which lets it exchange data with Windows-based spreadsheets and databases. DDE calls can be included in AutoLISP routines and ADS applications, giving the package much of the same flexibility and power of the DOS product. If you need DDE links, or are a dedicated Windows user, opt for this version. Release 12, however, will certainly meet and exceed most user needs and provide all the power needed for design projects.

Cadkey Inc.

Cadkey 5

DataCAD

BY WILL SCHLETER

Cadkey Inc. is a well-known player in the PC CAD marketplace. Its flagship product, the \$3,495 Cadkey 5, represents one of the few PC systems that encompass the range of mechanical-design applications from 3-D wireframe to detail drafting to solid modeling and analysis. Its sibling, the \$2,995 DataCAD, offers 2-D drafting and 3-D design and wireframe capabilities specifically intended for architects.

You can choose Cadkey's commands from its nine item menus, using either function keys or a mouse. Context-sensitive help is always available,

and the voluminous reference manual is well-written and organized. An on-line tutorial helps make this an easy-to-learn-and-use system.

Modeling the test drawing of the gear was easy with Cadkey. The program encourages you to create a 3-D wireframe model of the part you are designing and then details the various views of the model in drawing layout mode. In this case, however, it was quicker and easier to get the desired results by simply drawing each view separately. Dimensions went on quickly and painlessly, but cross-hatching the gear proved to be cumber-



To create this gear drawing in Cadkey 5, we found it quicker to draw each view separately rather than drawing a wireframe first.



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Internal i487 math coprocessor
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IBM mouse
5 slots/5 bays
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⁵ ThinkPad 300 and 700C systems and options are manufactured in Japan. PS/ValuePoint 6312, 6314 and 6319 Color Displays are manufactured in Korea.

¹¹ PRODIGY will not run without a modem. A modem is not included with the ThinkPad 700C. A customer who acquires the ThinkPad 700C and a modem which operates at a speed below 9600 bps may contact Prodigy to obtain a One-Month Free Trial Membership.

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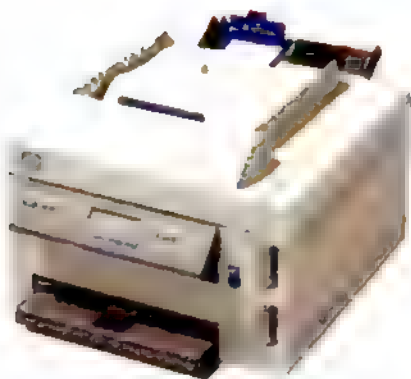
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ThinkPad 700 and 700C Options

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ThinkPad 300 Options

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the doors and windows are to be inserted. Switching between the two different systems is annoying, but we created an impressive perspective view of the finished design.

DataCAD implements many functions with macros that are included with the system. An example is DataCAD AEC, a macro that automates many of the operations required to draw commercial buildings. It automatically sizes and places objects such as columns, plumbing, and elevators according to accepted industry standards.

To give DataCAD a try without investing a large amount of money, try DataCAD 128, a \$99 fully functional version of DataCAD with one limitation: The drawing file size is limited to a sparse 128K.

If day in and day out your job is architectural drafting, then DataCAD, Version 4.06, may be the tool for you. For the full-time mechanical-CAD user who needs the increased productivity of a dedicated product, the choice should be Cadkey 5. Neither product is recommended for casual use on a variety of applications.

Isicad Inc.

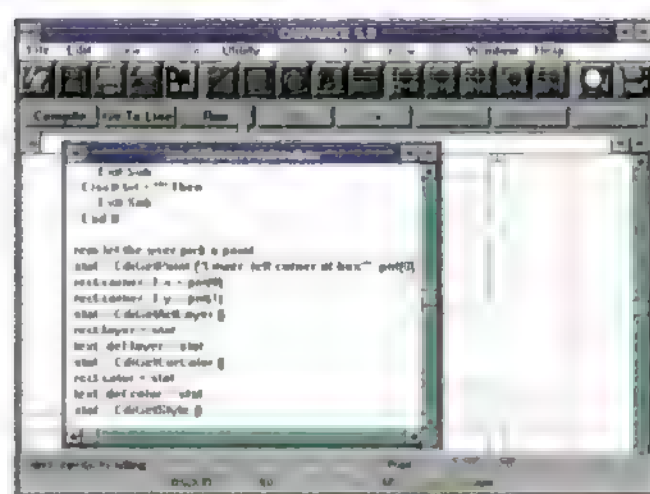
Cadvance 4.02

Cadvance 5.0 for Windows

BY JEFF PROSISE

As PC CAD packages go, Cadvance 4.02 (\$1,995) and Cadvance 5.0 for Windows (\$1,995) represent a departure from the norm. Strong on information management and networking but somewhat lacking in traditional drafting capabilities, both aim squarely at the ever-growing architecture/engineering/construction (A/E/C) market and hit the bull's-eye by providing workable solutions to some of information gathering and sharing's stickiest problems.

Unlike traditional PC CAD programs, which store nongraphical drawing attributes internally and then allow you to export them to third-party database managers, Cadvance 4.02 stores attribute data in .DBF files. If you need to perform sophisticated queries on attribute data or produce complex reports, all you need to do is fire up your favorite dBASE-



Cadvance 5.0 for Windows features a BASIC-like language called Cadvance BASIC Language (CBL), which lets you write custom commands.

compatible database manager. This division of labor makes Cadvance a natural choice for information-intensive A/E/C applications.

Cadvance also scores highly for its networking capabilities, which are as sophisticated as any you'll find in today's crop of CAD programs and which performed flawlessly during testing. In addition to locking drawings, Cadvance permits users to both place their names in a queue in order to wait for a locked drawing to become available and open locked drawings in read-only mode. Cadvance locks individual database records when they are accessed and automatically frees up network licenses when the server crashes with users logged in. If you prefer, Cadvance may be installed on the network file server rather than on individual workstations to reduce maintenance time and costs.

WELL-OILED

In most respects, Cadvance's user interface is remarkably well oiled. The main menu appears in the right margin of the screen; to its left is a context-sensitive submenu. Important drawing parameters such as snap mode, coordinate entry mode, and the current cursor coordinates, are displayed at the bottom of the screen. To change one of these settings (or to

enter cursor coordinates manually), all you have to do is click on the screen item. Most display management commands can be nested inside other commands. The only criticism of the environment is that it is not visually oriented. For example, you can't select a symbol from a menu; it's essential that you remember a symbol's file name.

Cadvance performed capably but did not excel on our drawing tests. Its inability to fillet between arcs (the side of a gear tooth and the gear's inner circumference) and difficulty in applying dimensions hampered its ability to recreate our mechanical drawing. A dimension's appearance is controlled by more than 50 parameters with values that are specified in a pair of setup screens. Achieving a certain dimension style (a diametrical dimension with arrowheads on the inside but dimension text aligned horizontally on the outside, for example) sometimes requires that these parameters be tweaked in rather subtle ways. Cadvance does not support associative dimensioning (in fact, a dimension is not treated as a single entity but as a collection of lines, symbols, and text). Nor does it provide an obvious mechanism for forcing dimension lines inside extension lines when it judges (sometimes erroneously) that there is not enough space. It supports a limited number of snap modes and can't snap to the midpoint of a line or to the point of tangency with an arc or circle.

Finally, hatch patterns cannot be scaled, so you'll have to create custom hatch patterns for most drawings.

Cadvance performs better with architectural drawing. It features a convenient 2LIN command for drawing double lines a specified distance apart and offers a nifty set of choices for cleaning up 2LIN intersections. Symbol creation and placement is fast and efficient, and symbols may be

SUITABILITY TO TASK				
Cadvance 4.02				
	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	☒	☒	☒	☐
Mechanical drafting	☒	☒	☐	☐
Workgroup drafting	☒	☒	☒	☒
Facilities management	☒	☒	☒	☒
Cadvance 5.0 for Windows				
	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	☒	☒	☒	☐
Mechanical drafting	☒	☒	☐	☐
Workgroup drafting	☒	☒	☒	☒
Facilities management	☒	☒	☒	☒



Performance Tests: 2-D Drafting Software

Drawbase 2000, with its protected-mode driver, and the low-priced Generic CADD turned in the fastest overall performance on PC Magazine Labs' tests. The \$199 EasyCAD 2 and its more expensive sibling, FastCAD, proved lightning-fast in performing floating-point operations and screen regenerations.

Those products with optimized plotting routines, assembly language floating-point code, and protected-mode video drivers proved to be the fastest performers. Drawbase 2000 was 17 times as fast as the slowest DOS package, VersaCAD/386, at screen regeneration.

Both versions of IBM CAD/Plus and TurboCAD failed the Screen Regeneration and Radial Copy and Rotate tests because they were unable to open our 17,600-entity .DXF file (they support a maximum of approximately 16,000 entities). Similarly, DataCAD was unable to complete the Radial Copy and Rotate test because its circular array is limited to 99 copies. We were unable to time Micro Cadam Plus because it allows only manual rotation. Optimized floating-point algorithms gave FastCAD, Generic CADD, Drawbase 2000, and Point Line Professional 2-D CADD their speed on the Radial Copy and Rotate test.

Some packages plot in the same order in which the lines and other entities are drawn, greatly extending the plot time. Generic CADD, Point Line Professional, Drawbase 2000, MicroStation Nexus, and MicroStation PC all performed admirably on the Plot to File test. The IBM CAD packages lagged behind as the slowest. On this test, the Microsoft Windows packages performed as well as the DOS packages.

HOW WE TESTED

We tested all the packages in this review on a Compaq Deskpro 486/33M configured with 8MB of RAM, a 310MB ESDI hard disk, and the ATI VGAWonder XL (which

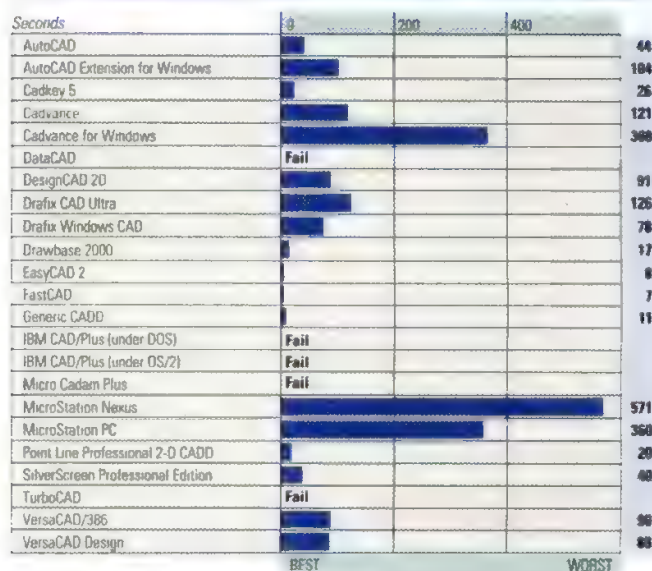
was one of the few universally supported cards).

To judge the **Screen Regeneration** speed, we measure the time required to regenerate a screen containing a rectangular array of 17,600 lines, circles, and arcs.

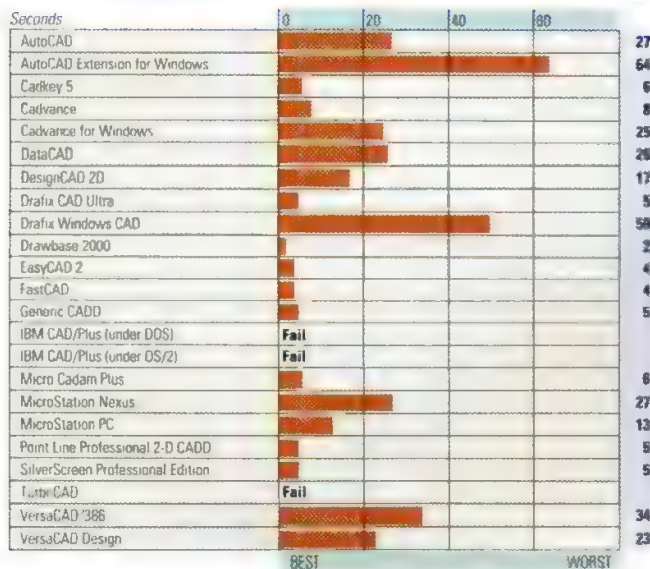
The **Radial Copy and Rotate** test gauges the software's raw floating-point performance by measuring the time each package takes to perform a trigonometrically intensive operation: creating a polar array of 359 copies of a group of entities arranged in 1-degree increments about a common center point.

To evaluate the speed and efficiency of the plotter driver, our **Plot to File** test measures the time it takes to plot a 5,300-entity drawing. All optimization features are enabled.

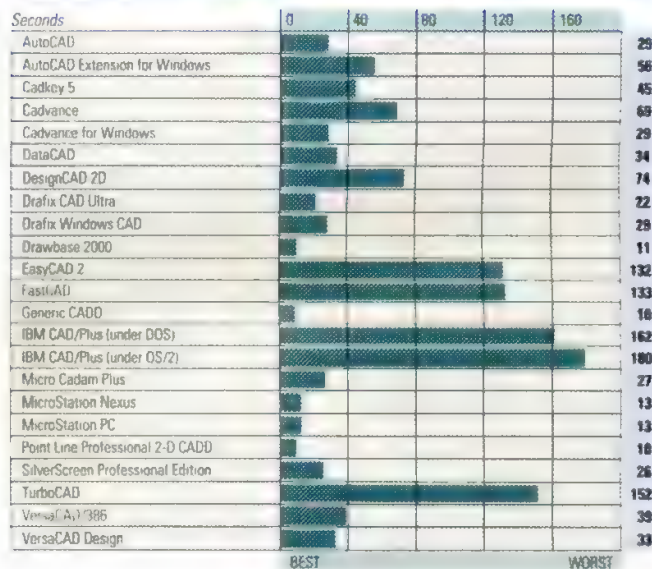
RADIAL COPY AND ROTATE



SCREEN REGENERATION



PLOT TO FILE



2-D Drafting

FACT FILE

Cadvance 4.02

List price: \$1,995.

Requires: 640K RAM, DOS 3.1 or higher, mouse or other input device, parallel port for hardware lock. Math coprocessor recommended.

Cadvance 5.0 for Windows

List price: \$1,995.

Requires: 386-based PC or better, 4MB RAM, 5MB hard disk space, DOS 3.3 or higher and Windows 3.x, mouse or digitizer, math coprocessor and 8MB RAM recommended.

In short: Isicad's Cadvance 4.02 is a high-end 2-D/3-D CAD program that blends extensive networking and data-management capabilities with adequate but less-than-distinguished drafting capabilities to form a product that is a natural fit for data-intensive facilities-management tasks. The Windows version retains the basic feature set of its DOS sibling and adds a few tricks of its own. If you expect networking to play an important role in your company's future, both products deserve careful consideration.

Isicad Inc., 1920 West Corporate Way,
P.O. Box 61022, Anaheim, CA 92803-6122;
714-533-8910



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rotated or scaled. Cadvance will not fill double lines, though. Nor will it trim a line to its intersection with a nonlinear drawing entity.

Predictably, Cadvance fares much better in tests of its data management capabilities. Attributes may be copied, assigned, viewed, and edited without leaving Cadvance. Extracting attributes from the architectural drawing and storing them in an ASCII file as the test script called for requires the creation of a macro (Cadvance supports a powerful macro programming language). But this slight deficiency is more than made up for by Cadvance's seamless handling of relational database files.

DOING WINDOWS

Cadvance 5.0 for Windows wraps the feature set of Cadvance 4.02 (including its extensive networking and data-management capabilities) in a Windows package and adds a few extra features. It's a capable Windows performer—at least from a features standpoint. Features included here, but missing from the DOS version,

are: a much-expanded set of snapping modes, dynamic data-exchange support, clipboard support, and the ability to edit multiple drawings simultaneously. Also included, if you have Pioneer Software's Q+E, is the ability to perform SQL (structured query language) queries on database files linked to Cadvance drawings. Cadvance for Windows also acts as an object linking and embedding server and client.

A BASIC-like programming language featuring a built-in editor and compiler makes the product highly extensible. Unlike the DOS version, Cadvance for Windows does not use a parallel-port key for copy protection. Also, you can directly import Cadvance 4.02 drawing files into Cadvance for Windows.

When you send in the registration card, you receive a two-way AutoCAD drawing translator. When importing Release 12 .DXF files, the program crashed repeatedly, sometimes after warning that the "Release 11" .DXF format was not fully supported.

We also found Cadvance for Windows' performance to be unacceptably slow when editing large drawings. On a 33-MHz 486, the package required minutes to highlight a selection consisting of thousands of entities. Until its speed is improved, Cadvance for Windows is more appropriate for A/E/C applications and small-to-medium-size drawings than it is for industrial-strength drafting work. Even the DOS version fared poorly in our most compute-intensive test, finishing near the back of the pack in the radial copy and rotate test.

If your work involves data-intensive facilities-management tasks, and if networking will play an important role in your company's future, then Cadvance and Cadvance for Windows deserve to be on the short list of products you evaluate. For pure drafting applications, however (particularly in standalone environments), there are other packages that will serve you better.

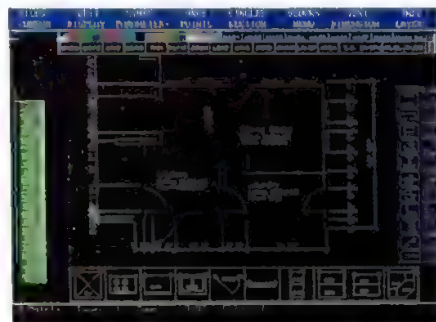
American Small Business Computers Inc.

DesignCAD 2D

BY BRYAN M. WINTER

DesignCAD 2D from American Small Business Computers is a case study of what can be achieved when a software producer commits to excellence. A great interface, logical commands, and vertical integration into 3-D combine with a great price (\$349) to make this former Editors' Choice a superior buy once again.

DesignCAD has a variety of features that you may not expect to find in a package you can buy at your local software store. Among these is BasicCAD, a programming language within DesignCAD. Most users will never need such sophistication, but it opens the way to third-party development; the extensive list of third-party software includes architecture and engineering symbol libraries and computer-aided manufacturing software. One of the package's unique features is its ability to create objects in standard or vector format. Creating objects in vector format gives you the object in its exploded form (three lines for the letter A, for example). You can edit the resulting objects only as drawing objects; you must re-enter text if you need to change it. You are limited to one default font style per drawing, though. To add additional styles, you must create the text



DesignCAD 2D has a Windows-like command that's easy to use and customizable icon menus that you can move around the drawing area.

as a vector object—a small sacrifice, given the adaptability of the package. A variety of fonts is available, but there is no hand-lettered architectural script. Fonts can be manipulated in a number of ways. You can easily change the style, size, and rotation of text, as well as create arced text and 4-point text definitions that allow you to create a variety of special effects. Text attributes are handled as descriptors of items but cannot replace displayed text.

The block feature is a critical part of this package that works as a selection set

for other commands, such as scaling and copying. Within a block command, you can carry out a series of editing functions, as well as define freestanding entities that can be used in any drawing. Blocks stay selected until you delete them, so you can perform several other commands and then come back to the block and manipulate it again.

Many CAD packages have verb/noun command structures. With this structure, you pick a command and then choose the objects or points that will be affected. Many CAD packages perform in the opposite way, but DesignCAD uses a combination of both approaches—in most cases allowing you to select objects before or after you choose a command.

DesignCAD 2D has a Windows-like command structure that you can easily pick up by browsing through menus and tutorials. If that doesn't work, there's a series of videos (available separately) that takes you from installation to productive work. Along with the main menu across the top, there are customizable icon menus that you can move around the drawing area while you work. These

SUITABILITY TO TASK

DesignCAD 2D, Version 5.0

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	●	●
Mechanical drafting	●	●	●	○
Workgroup drafting	●	●	○	○
Facilities management	●	●	●	○

menus give a graphic edge to the learning curve and are valuable for users who like to work in a more "heads-up" mode: more screen, less keyboard. Although DesignCAD isn't a true Windows package, it can run under that operating environment and can use Windows-like cut-and-paste commands. Most basic construction techniques, as well as an included assortment of fonts and hatch patterns, are accessible via well-designed pull-down menus.

In addition to these menus, there's a command line that can be toggled on and off. You can enter commands in typed form or choose single keystroke commands without opening the command line. The single-keystroke commands de-

velop into powerful tools after some use, though they can be confusing to the novice. A programmable digitizer interface is also available. Overall, the company has taken pains to vary the command input methods, so you can find what works best for you.

GOOD FILE EXCHANGE

If you need .DXF or IGES files, have no fear. You can easily

generate exchange files from within DesignCAD and ship them to clients or other programs for use. In general, these exchanges are handled quite well. The conversion is fast, and there are several formats to choose from, including IGES, .DXF, .PCX, and even Renderman format. A built-in viewer lets you display graphic files on top of the drawing area while you work.

DesignCAD proved to be particularly adept at handling our test floor plan. It did a good job of calculating the floor areas in our diagram and had no problem creating double lines and filled walls during the test. Especially useful are its built-in hatch patterns and wide array of available architectural and electrical symbols. The package handles dimensioning and attributes in a Spartan but sufficient way. All that's needed for basic design work is included, though the package lacks some of the less-frequently used dimensioning styles. The limited options do make DesignCAD 2D less confusing, however.

One feature that could use improving is the undo command, which currently lacks the ability to undo entire complex tasks in a single keystroke. This would seem to be a concession to low-end system owners, since a task record would require memory that is at a premium on less-powerful systems. Another apparent sacrifice to compactness is the limited color and layer support. DesignCAD currently offers support for only 16 colors and 63 layers. The limited number of layers means that the package is not as use-

FACT FILE

DesignCAD 2D, Version 5.0

American Small Business Computers Inc.,
One American Way, Pryor,
OK 74361; 918-825-4844;
fax: 918-825-6359

List price: \$349.

Requires: 286-based PC or better, 640K RAM, 2MB hard disk space, DOS 3.0 or later. 2MB RAM recommended.

In short: A powerful CAD program at an extremely reasonable price, DesignCAD 2D has only one real—though significant—flaw: its decidedly sluggish performance.



ON READER SERVICE CARD

ful as it might be for complicated drawings, but 63 layers is more than enough for regular use.

DesignCAD 2D does 90 percent of what industry-leader packages do—at around a tenth of the cost. With its powerful drafting tools, BasicCAD programming language, and host of other features, DesignCAD is a great buy. Although strictly a

2-D program, it can be upgraded to DesignCAD 3D (\$499). The company also sells DesignCAD Professional (\$995), which is a bundle of both the 2-D and 3-D packages, as well as DesignSYM (symbol libraries), SmartEST (an estimating program), and ScanPRO (raster-to-vector conversion software).

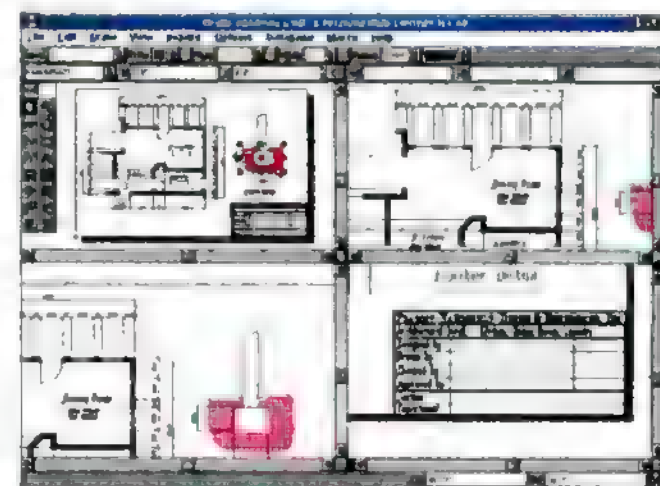
Foresight Resources Corp.

Drafix CAD Ultra

Drafix Windows CAD

BY ROD TAYLOR

With the introduction of the \$695 Drafix Windows CAD, Version 2.1, and the \$395 Drafix CAD Ultra, Version 4.2, Foresight Resources Corp. continues a tradition of delivering cost-effective solutions to today's 2-D drafting needs. Both packages offer similar drafting tools and database capabilities unique to the CAD marketplace, but their interfaces are dif-



Drafix Windows CAD can display up to four views of a drawing at the same time; when you make changes in one, the other three are updated.

2-D Drafting

ferent enough to make them distinct.

Drafix Windows CAD boasts a well-designed user interface, robust geometry creation/editing commands, a macro programming language, database export capability, and a 30 percent improvement in redraw speed over its previous release. But be warned: Windows CAD is much slower than CAD Ultra at display redraw. Our benchmark tests found a tenfold decrease in screen-regeneration speed for Windows CAD as compared with CAD Ultra.

While the look and feel of this version have remained the same, Foresight Resources has added Windows 3.1 TrueType font support, context-sensitive online help, improved file import/export filters, interruptible screen redraw, and halt menu commands. Windows CAD now includes intelligent cursor control, associative dimensioning, up to 4 drawing windows, and 14 entity snap modes.

The Windows CAD display screen is designed to give you plenty of helpful information while you create a drawing. You use the menu bar to access the pull-down text menus and the status bar to change the color, layer, or style of geometry you create without having to exit the current drawing command. The icon toolbox provides quick and easy access to drawing commands and makes operations such as trimming and scaling a breeze. Dragging a "split" box toward the center of its scroll bar causes the drawing area to be split into two or four separate panes.

An even more dramatic difference between Windows CAD and the low-cost competition is its unique database capability. Windows CAD lets you assign information such as price, part number, and color to entities in a drawing. Collectively referred to as database attributes, this in-

formation can be exported to any popular database or spreadsheet program to create a bill of materials, price estimate, or inventory report. This is especially convenient for construction planning or facilities management. Changes to your drawing are automatically made to the database or spreadsheet; the package also supports dynamic data exchange with Microsoft Excel.

Windows CAD

displayed a few problems during testing. Most obvious was its inability to create and position dimensions to the test specifications. On our test gear drawing, Windows CAD was unable to apply arrowheads correctly on radial or diametrical dimensions. Text alignment for horizontal and vertical dimensions was tricky during testing; Windows CAD sometimes insisted on placing the text below the horizontal dimension lines and also had problems rotating vertical dimensions.

Circle or arc entities, when deleted, often left a residue on the display; artifacts would also be left on the screen when bringing symbols into the drawing. A simple screen redraw was all that was needed to get rid of them.

DRAFIX CAD ULTRA

Like its Windows-based sibling, Drafix CAD Ultra possesses database capabilities, in addition to hierarchical screen menuing, well-written documentation, good geometry creation/manipulation capabilities, and a library of more than 400 object symbols.

This is the first release of CAD Ultra to use extended memory without requiring the purchase of a memory-upgrade kit, although Foresight recommends you have at least 2MB of extended memory available to take advantage of this capability. CAD Ultra also provides full digitizer support and includes a tablet menu

overlay for easy access to the most commonly used commands. Any digitizing macro you write can be attached to a tablet menu button.

The need to memorize command sequences in CAD Ultra has been basically eliminated, since all functions are organized under a dynamic, hierarchical menuing scheme. You always see the menu selections you've made and what your current mouse-button options are. In addition, CAD Ultra offers compatibility with AutoCAD, Release 11, .DXF files; support for multiple line widths and international character sets; and faster screen redraws than the previous release manages.

Also new is direct support for network and multiuser operation. This lets users run multiple copies of CAD Ultra at the same time from a network server. A file-locking mechanism is enforced by the system to keep a drawing from being accessed by more than one user at a time. Additionally, each computer used to run CAD Ultra over the network can be configured to a particular user's preference.

FACT FILE

Drafix CAD Ultra, Version 4.2

List price: \$395.

Requires: 640K RAM, 4.5MB hard disk space, DOS 3.0 or later (3.2 for networks).

Drafix Windows CAD, Version 2.1

List price: \$695.

Requires: 286-based PC or better, 3MB RAM, 5MB hard disk space, DOS 3.0 or later (3.2 for networks), Windows 3.x, mouse

In short: Drafix CAD Ultra is a fundamentally good program with a quirky interface and limited dimensioning skills. The Windows version is an occasionally slower, more expensive version of the DOS product, with a much more elegant interface and better inter-application connectivity. Both products are powerful programs that give users automatic database linking and the ability to generate architectural/electrical drawings without a lot of fuss.

Foresight Resources Inc.,
10725 Ambassador Dr.,
Kansas City, MO 64153;
800-231-8574, 816-891-1040;
fax: 816-891-8018

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SUITABILITY TO TASK

Drafix CAD Ultra, Version 4.2

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting				
Mechanical drafting				
Workgroup drafting				
Facilities management				

Drafix Windows CAD, Version 2.1

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting				
Mechanical drafting				
Workgroup drafting				
Facilities management				

GRAPHICS 2-D Drafting

CAD Ultra includes a 14-lesson tutorial that will get new users up and running in no time. The symbol library guide provides an overview of the 433 symbols included with the package. CAD Ultra lets you position, scale, or rotate these symbols before inserting them into the drawing. It also lets you update the library with your own symbols. Also included in the package are function-key macros, database-attribute support for symbols, and a simple report generator.

Foresight offers several accessories to complement its CAD Ultra product. These include an IGES translator; thorough symbol libraries for architectural, mechanical, electrical, and computer-network design; a 3-D surface modeler; a raster-to-vector conversion utility; and a facility for generating customized reports from drawing attribute data.

CAD Ultra isn't perfect, though. It applies radial and diametrical dimensions in a manner inconsistent with standards set by the American National Standards Institute. It makes dimension positioning unnecessarily difficult, and it does not support toleranced dimensions. If you run CAD Ultra in a high-resolution screen mode, menu selection with the cursor becomes tricky. The cursor is so large that you must position it carefully when making a menu selection.

All in all, both of the Drafix products are powerful programs that offer much in the way of 2-D drafting. Both give you automatic database linking and the ability to generate architectural/electrical drawings without a lot of fuss. Windows CAD is the easier of the two to learn and use, but both products are worth a closer look. If your work depends heavily on dimensioning of mechanical/machined parts, the Drafix products probably aren't for you; the difficulty both have applying radial and diametrical dimensions makes them unfit for this purpose.

CADWorks Inc.

Drawbase 2000

BY BRYAN M. WINTER

Sometimes the whole is greater than the sum of its parts. Such is the case with the Drawbase family of CAD products. Drawbase 2000 (\$2,000) by CADWorks serves as the 2-D base module of the se-

ries. But it would be rare that a firm would buy Drawbase 2000 without thinking about an eventual upgrade—only \$500—to another Drawbase product.

Drawbase 3000 (normally \$3,300) is a 3-D system, Drawbase 4000 (\$4,400) offers database capabilities, and Drawbase 5000 (\$5,500) combines both. Those who choose to stick with the base system, however, will find that Drawbase 2000 is a complex but capable package for 2-D design.

Originally based on Skok Systems' turnkey minicomputer-based program, the Drawbase products have evolved from the Unix platform and still do some things the Unix way. Each

drawing is made up of five files: a Drawing file, an Attributes file, a Forms file (which links the attributes to the drawing), a Key file (which contains the 3-D information), and a Management file. Some of the files, such as the Key file, are not important to basic 2-D; fortunately, you can bypass them by working in a compact drawing format. These extra files become important if you upgrade to: Drawbase 3000, which adds 3-D capabilities to the basic 2-D drafting options; Drawbase 4000, which links a database to the drawing file; or Drawbase 5000, which has both a database and 3-D tools.

In a networked environment, it would not be uncommon to mix and match the different Drawbase packages around a common server. Junior drafters can use 2000, designers might use 3000, and managers can opt for 4000 and 5000. Although networks are well supported, the program must be run locally to access the hardware lock that connects to a machine's parallel port. The package does not use operating system-level file locking, however. Instead, it uses DOS to create read-only copies of files in use.

Drawbase 2000 offers a less-than-comprehensive selection of hardware drivers, probably because the product is marketed through value added resellers. With low-cost video cards and display-list software able to compete with TIGA

cards in most work, CADWorks limits its drivers to a series of high-end boards that provide only moderate support for VGA and Super VGA. You'll probably want to use two monitors when running this package; fortunately, most of the boards supported are up to the task. HPGL 2 is built in for plotters and output, but the printer choices are limited.



Drawbase 2000 offers wall layout commands and a macro that cuts doors in walls, both of which make it particularly good for architectural drafting.

The input-device problem is more severe. Drawbase is almost totally dedicated to a digitizer menu system that is cumbersome but good for the veteran user. There are no menus on-screen, except point-selection modes, and keyboard input is difficult—relying on

digitizer addresses instead of even mnemonic commands. An example of this is the "Draw hatch" command. To start it, you must either pick the box on the template or type "6D" and then Ctrl-F10. Given those options, it is no wonder that only a single mouse driver (Logitech C7) is provided—and probably rarely used, due to the lack of pull-down menus.

Many other control commands are present, but they are nowhere to be found

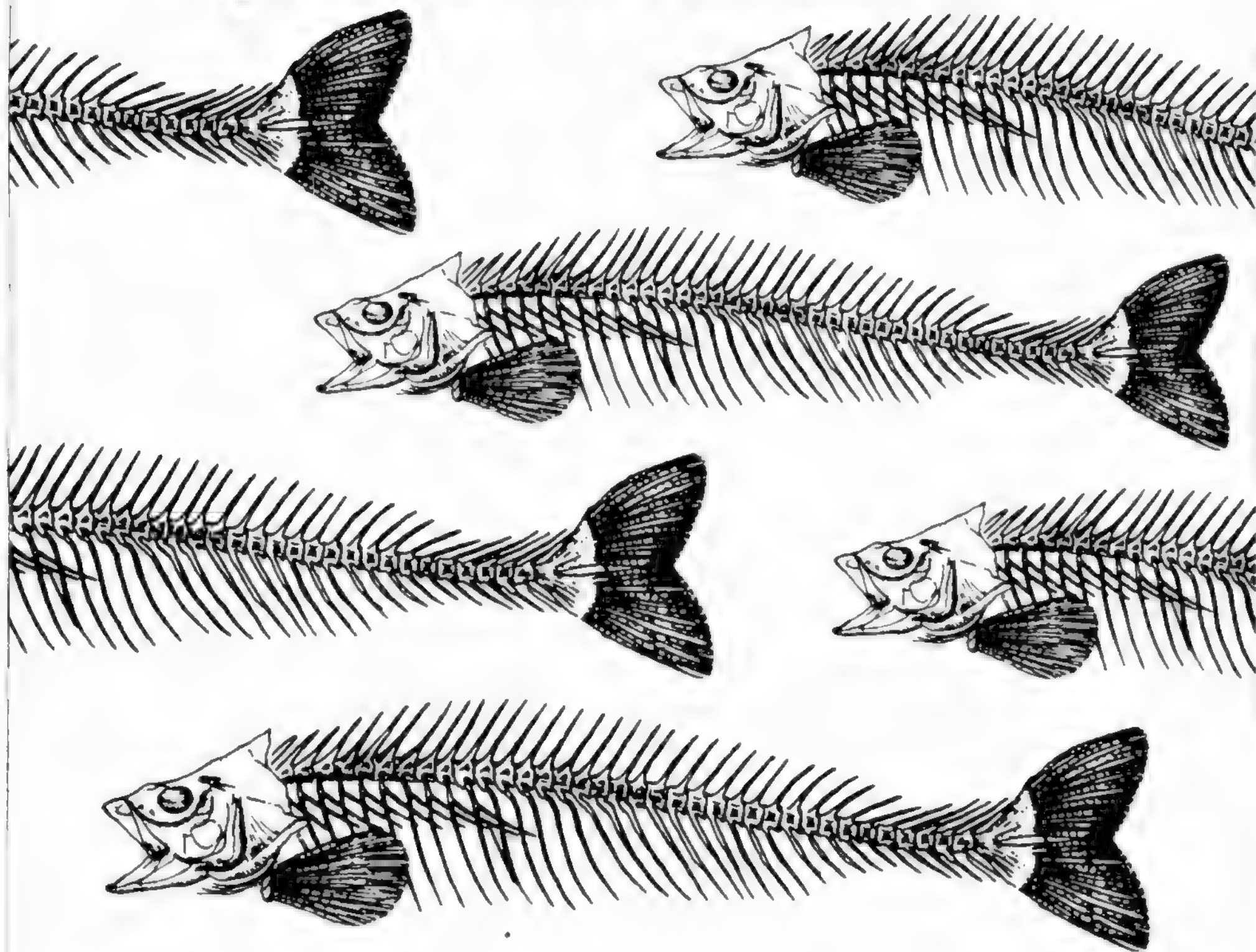
SUITABILITY TO TASK

Drawbase 2000, Version 108

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	☒	☒	☒	☐
Mechanical drafting	☒	☒	☐	☐
Workgroup drafting	☒	☒	☐	☐
Facilities management	N/A			

in menus. With computers getting smaller and design offices often on site or on the road, Drawbase's reliance on a digitizer seems archaic; when you consider that the package will run under Windows, a heads-up program that represents an antithesis to the Drawbase interface, this choice seems even more confusing. A Windows version of Drawbase is due out soon and should rectify some of these shortcomings.

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The Christmas Seal People[®]

2-D Drafting

FACT FILE

Drawbase 2000, Version 108

CADworks Inc.,
222 Third St., Cambridge,
MA 02142-1159; 617-868-6003;
fax: 617-354-3057

List price: \$2,000.

Requires: 386-based PC or better, 640K RAM, 20MB hard disk space, DOS 3.0 or later, serial port for hardware lock. Math coprocessor, 4MB RAM, digitizer recommended.

In short: This is certainly a capable product—but one that should not cost quite so much or be quite so difficult to use.



The digitizer interface poses less of a problem when you reach the top of the learning curve. To get you there, Drawbase offers tutorials that have macro-generated, movie-like playback of the commands as they should be executed. This is an impressive display of both the power of the external programming language and the foresight of its designers. After the tutorials, the manual is well thought out. But because the same manual must serve all of the Drawbase modules, it contains chapters that Drawbase 2000 users simply don't need. They can be easily removed, though.

ADEPT AT DRAFTING

For 2-D drafting, Drawbase offers all of the basic commands necessary for geometric construction. Lines, circles, and arcs all have good construction methods that can be used in any type of drafting. In addition, the package offers a set of wall layout commands that are well suited to architectural drafting. Even more useful for architects is a macro that can be used to automatically cut doors in walls. This feature let Drawbase breeze through creation of our test floor plan. The package also offers a separate command set for construction lines that makes them easy to use for defining complex geometries. These construction lines work much like a draftsman's T-square, allowing you to quickly lay down and rationalize the complex geometries of a building before the final line work is added to the drawing.

Text and hatch patterns are easy to

manipulate, though their options are at a minimum. Editing features cover a range of methods and work with construction lines to trim, copy, or make other changes as required. The package allows you to enter multiple choices at a prompt. For example, you can enter the pen and line type simultaneously. This grouped information is easy to control and efficient to work with. Unfortunately, the package lacks a multiple undo command and has only limited third-party support.

Drawbase 2000 is not the package to choose if you use CAD only occasionally or if your budget is small. If you specialize in architecture or facility management, you should upgrade to one of the other Drawbase products or work in an environment where the full suite will be used; this would be the better choice. Inflexible and difficult to learn as a standalone, Drawbase 2000 cannot be recommended.

Evolution Computing

EasyCAD 2

FastCAD

BY WILL SCHLETER

When it comes to speed and ease of use, EasyCAD 2, Version 2.72 (\$199), and FastCAD, Version 2.72 (\$795), from Evolution Computing can't be beat. At first glance, these two systems seem almost identical to each other; they share the same user interface, the same data files, and the same penchant for high speed. EasyCAD is positioned as an entry-level 2-D CAD system with no expandability, and FastCAD provides additional features, including the ability to have other applications linked to it. With a rigid structure streamlined for speed, these systems don't possess all of the bells and whistles of some of their competitors, but EasyCAD and FastCAD always seem to get the job done.

EasyCAD and FastCAD both use

pull-down menus, icons, and dialog boxes for interacting with users. In addition, all operations have a keyboard equivalent command that is used mainly in programming macros. From starting up the system to zooming to selecting entities and displaying file lists, everything about these systems is quick and snappy. Using commands (which are just a click or two away) is also smooth and virtually effortless.

The manuals for both systems are excellent; FastCAD provides a getting-started manual and a reference manual, and EasyCAD packs both topics into a single user guide. In both cases, a set of tutorial lessons step you through the process of learning the systems. Data files are interchangeable between the two packages, and the sizes of the files are minuscule when compared with those of other CAD systems. A bidirectional .DXF translator is built into each system, which allows you to easily exchange data with other applications. Both EasyCAD and FastCAD run without noticeable delay as full-screen DOS applications under Microsoft Windows 3.1.

EasyCAD and FastCAD performed well on our two test drawings, with a few notable exceptions. Cross-hatching is implemented as an area fill in both systems; therefore, you don't have control over the angle and spacing of the hatch lines. Furthermore, because it requires that a fill boundary be a single entity, EasyCAD must really struggle when it comes to filling an area such as that found in our

test gear drawing. FastCAD, while also suffering from this restriction, improves the situation by supporting a complex entity that lets you combine entities such as lines, curves, and text in order to fill more complex boundaries.

Neither system has the double-line

capability commonly found in most architectural packages, so in order to create the walls in our test floor-plan drawing, we had to draw them one line at a time. Finally, neither system has any attribute



EasyCAD 2 uses pull-down menus, icons, and dialog boxes that make the program both intuitive and virtually effortless to use.

GRAPHICS

2-D Drafting

SUITABILITY TO TASK

EasyCAD 2, Version 2.72

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	○	○
Mechanical drafting	●	●	●	○
Workgroup drafting	●	○	○	○
Facilities management	●	○	○	○

FastCAD, Version 2.72

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	○	○
Mechanical drafting	●	●	●	○
Workgroup drafting	●	○	○	○
Facilities management	●	○	○	○

or bill-of-material capability. On the plus side, a unique Connect command was useful to move, scale, and rotate the gear tooth in a single step in order to generate the detail view.

EASY PICKINGS

A good example of the attention to detail found in EasyCAD and FastCAD is the way entity selection is handled. Every time you are prompted for an entity selection, you get a dialog box that allows you to choose a selection method from the following: Each, Window, Layer, All, Type, Color, or Same. Once you have made a choice, you have the opportunity to continue with additional selections in AND, OR, or NOT combinations. This approach gives you the widest possible set of selection options. If, however, most of your work entails selecting only a few entities at a time, you have the option of turning the dialog box off and using either single or window selection exclusively.

Several different methods can be used to tailor both products to meet your needs. Scripts allow the automation of repetitive tasks by simply playing back commands exactly as if you had entered them interactively. The Action facility lets you associate commands or parameters with a location on your drawing. When you have created an action in your drawing, just click on the location to perform the desired function. For example,

you can define an action for each component of an assembly and have that action load the detail drawing of the selected component.

Another method of customization is editing menus; EasyCAD and FastCAD menus are stored as text files, allowing you to reword, reorder, add to, and subtract from the on-screen menus. Finally, a macro facility provides a programming language with user input, variables, conditional branches, and looping.

What are you paying for when you buy FastCAD instead of EasyCAD? Primarily expandability; FastCAD implements external-procedure modules that give other applications direct access to FastCAD's internal data structures, thus allowing sophisticated applications to become an integral part of the system. A second important difference is the extra set of icons on the right side of the FastCAD screen. These icons give you instant access to commonly used commands and allow you to use commands such as Zoom and Pan in the middle of other operations. Multiple windows, dynamic drag,

a plot-assembly feature, independent x,y scaling, and optimized versions for the various processor types are also found only in FastCAD. A final difference is that EasyCAD 2 can run with or without a math coprocessor, and FastCAD requires one.

A good example of FastCAD's extensibility is FastCAD Plus from Evolution Computing (\$199 to registered FastCAD users). Adding this module to FastCAD provides you with icon tablets. These on-screen tablets provide instant access to many existing FastCAD commands—in addition to providing some badly needed help with trims, dimensioning, and hatching. If you need to move into the 3-D CAD world, a separate product called FastCAD 3D with FastCAD RenderMan (\$2,995 retail, \$1,797 upgrade) will allow you to create photo-realistic images, complete with surface textures and multiple light sources.

The best CAD deal in town may very well be the book *Learn CAD* by George Omura (Microsoft Press, 1991). For \$39.95, you get a fully functional—though slightly stripped down—version of EasyCAD, as well as an introductory book that steps you through the process of learning CAD. The book includes a coupon for upgrading to the full version of EasyCAD for only \$79.95.

While you may at times have to do a little extra work to get things accomplished, FastCAD and EasyCAD are two of the quickest and easiest-to-use systems available in the PC CAD marketplace today. If you are a casual CAD user and don't need specialized add-on applications, EasyCAD is the system for you. For specialized applications, FastCAD is an excellent building block for a customized system.

▶ FACT FILE

EasyCAD 2, Version 2.72

List price: \$199.

Requires: 640K RAM, DOS 2.1 or later, mouse or other pointing device. Hard disk drive with 2MB free recommended (will run from floppies).

FastCAD, Version 2.72

List Price: \$795.

Requires: 640K RAM, DOS 2.1 or later, mouse or other pointing device, hard drive with 2MB free recommended (will run from floppies).

In short: Though somewhat limited in dimensioning and geometry options, FastCAD and EasyCAD 2 are both extremely clean and easy-to-use packages. Assembly-language coding makes these systems lightning fast. Unless you need the multiple windows and additional expandability that FastCAD offers, EasyCAD represents a much better value. These are two of the quickest and easiest-to-use systems available in the PC CAD marketplace today.

Evolution Computing,
437 South 48th St., # 106,
Tempe, AZ 85281-9936;
800-874-4028, 602-967-8633;
fax: 602-968-4325



ON READER SERVICE CARD

Autodesk Retail Products

Generic CADD

BY WILL SCHLETER

Labeling something generic sometimes implies that it is bland and of lesser quality. Not so with Generic CADD, a \$495 package from Autodesk Retail Products. Generic CADD takes the meaning of generic literally: It is a tool that is flexible enough to be used for almost anything. Version 6.0 adds built-in .DXF conver-



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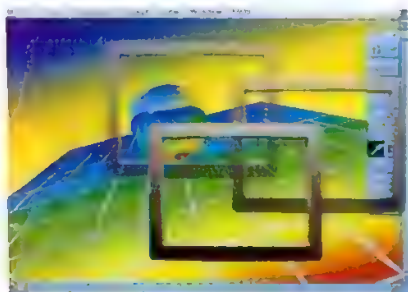


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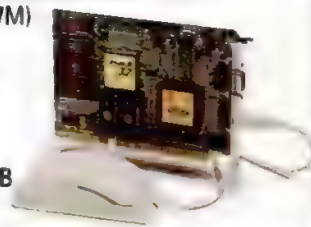
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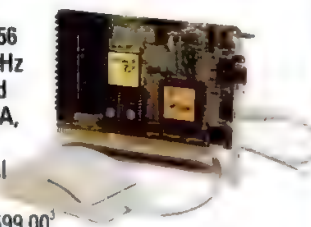
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GRAPHICS

2-D Drafting

sion support and the ability to read AutoCAD .DWG files to an already impressive array of features, making Generic CADD an excellent choice for all 2-D design and drafting applications.

After you complete the effortless installation program, which loads almost 12MB worth of files, a standalone setup program allows you to specify your display adapter, pointing device, and memory configuration. Since Generic CADD supports extended memory, expanded memory, and/or virtual memory (paging to disk), it should fit well into just about any hardware configuration. As with most of the 2-D-only products in this review, Generic CADD has a 3-D compatriot, Generic 3D Drafting (\$399). And if your drafting needs run to the very basic, AutoSketch for Windows (\$299) allows you to sketch designs easily in a much easier-to-learn environment.

Once you start the program, you'll notice the drawing area is surrounded by a status line at the top of the screen, a menu area on the right, and a status/interaction area on the bottom. You select commands from the on-screen menu with the mouse or by typing two-letter commands.

SUITABILITY TO TASK

Generic CADD 6.0

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	☒	☒	☒	☐
Mechanical drafting	☒	☒	☒	☒
Workgroup drafting	☒	☒	☐	☐
Facilities management	☒	☒	☒	☒

While the two-letter commands seem awkward at first, they offer a quick and efficient way for the experienced user to access any function directly. A handy quick-reference card lists all the command abbreviations and cross-references them to a page in the reference manual; the user's guide introduces you to the system with a getting-started section and



Generic CADD's robust set of selection options include window, individual object, layer, and object type, and they can be used individually or combined.

rubberbanding as they are being created or modified, and a percentage-done indication is given for most time-consuming operations. A plot-preview capability allows you to see exactly what will be plotted and how it fits on the paper before you send the drawing to your printer or plotter. During plot preview, you can change the rotation, scale, and origin and see the results before you put the pen to the paper—a very useful feature not found in many systems.

A comprehensive set of selection options allows you to select or deselect objects using almost any combination of window (all inside or crossing), individual object, layer, entire drawing, color, object type, width, text attributes, and the last selection set. While this capability gives you the greatest flexibility, it can make selecting just a few objects a chore. Also, the program lacks the ability to select objects within a polygonal boundary.

Generic CADD defaults to drawing lines if no other command is selected, and every command always returns to line mode without repeating. Therefore, to create two circles in succession, you must select the circle command twice. You can use the Spacebar to select the previous command, somewhat streamlining this repetitive process. A powerful undo command, appropriately abbreviated as OO, allows you to undo up to 25 operations. Things that are inadvertently undone can be brought back with the "redo" command. Most operations are protected by the undo command, and for those that are not, you are adequately warned before they are performed. All systems should be so forgiving.

Creating our test drawings demonstrated the flexibility of Generic CADD.

several tutorial lessons. A customization guide and an installation and troubleshooting guide round out the well-organized and professional documentation.

Interactive feedback is an area in which Generic CADD excels. Objects are dynamically displayed with

The gear drawing and the floor plan were created with ease. A dimension multiplier setting, hidden under the tolerance settings, allowed the dimensions in the detail view of the gear tooth to display the desired values and to remain associative even though the geometry had been scaled up. Associative dimensions and the stretch function allowed the gear width and pitch diameter to be modified with minimal effort. Double lines and an interactive intersection trim proved useful while creating the floor plan, and the use of components with attached attributes allowed door and window schedules to be created automatically. Since Generic CADD comes with more than 35 fonts, 50 hatching patterns, and 500 symbols, you can give your drawing a professional look for almost any application.

MIXED METAPHORS

For the most part, Generic CADD is an easy-to-use system, but it suffers somewhat from its mixed-mode interface. While most of the zoom, snap, and constraint commands can be nested (accessed while performing another command), you must type the commands from the keyboard or program a key to access them; you can't simply select them with the mouse. Most commands are logically named and positioned, but a few are hidden and difficult to use. For example, to change the height of existing text, you must choose Edit from the text menu. As you might expect, this puts you in position to change the contents of the text. Then, although there is nothing on the



FACT FILE

Generic CADD 6.0

Autodesk Retail Products, 11911 N. Creek Pkwy., South Bothell, WA 98011-9914; 800-228-3601, 206-487-2233; fax, 206-485-0021

List price: \$495.

Requires: 640K RAM, 2MB hard disk space (9MB recommended), DOS 3.0 or later.

In short: For a variety of mainstream 2-D drafting applications, Autodesk Retail Products' Generic CADD 6.0 proves itself an extremely capable package that boasts an attractive price. Organizations that need both high-end and low-cost seats will find the combination of Generic CADD and AutoCAD an appealing option.

 ON READER SERVICE CARD

2-D Drafting

screen to prompt you, you must know to click the left mouse button and key in the command TS (for text settings) to be able to alter the height. Only one text object at a time can be modified in this manner, and to confuse the situation even more, most other text settings can be changed with the use of the TG (Text Change) command.

Generic CADD provides several features that help you work more efficiently with large drawings. These include a win-

Generic CADD excels in the area of interactive feedback. Objects are dynamically displayed with rubberbanding.

dow redraw that allows you to specify only a portion of the screen to update; redraw interrupt along with forward or backward redraw that allows you to stop a screen redraw after the portion you are interested in has appeared; and a set of options to toggle the display of text, hatching, fills, drag, rubberbanding, and highlighting that allows you to streamline your working environment.

Although at times a bit difficult to use, Generic CADD is a powerful and versatile system that provides virtually all the features of systems costing far more. If your drafting chores are varied, Generic CADD is an excellent choice.

Cadcam Inc.

IBM CAD/Plus

BY EVAN YARES

IBM CAD/Plus is one of the true enigmas of the CAD world. It is a general-purpose high-end 2-D CAD program—which alone is confusing in a market populated by high-end 3-D and low-end 2-D CAD programs. And even though it was developed by high-profile IBM Corp. (Cadcam is a subsidiary of IBM), IBM CAD/Plus is one of those programs that members of the general computing public have never really heard of.

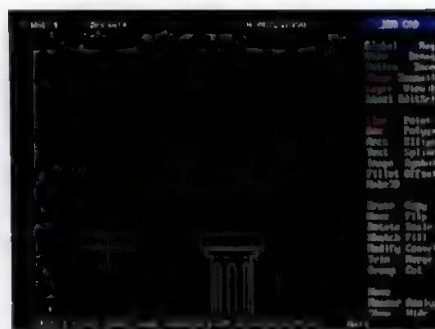
Actually, IBM CAD/Plus has been

around for several years. IBM offers two versions of the product: IBM CAD (\$1,595) and IBM CAD/Plus (\$2,295). The "Plus" adds a comprehensive internal programming language (CADForth) and several translation utilities. IBM CAD/Plus runs under DOS or OS/2, although the OS/2 version is a simple port of the DOS version, with no change in functionality. You don't have to choose between operating systems: The package includes disks for both.

The current version of IBM CAD/Plus is a very mature and capable product, but it has a look and feel straight out of the mid-1980s. It uses a text-based menu system on the right side of the screen, with options appearing at the bottom of the screen. The balance of the screen is used for graphics. The program displays up to 16 colors. Although 256 colors would be nice, 16 seems adequate for a 2-D CAD system.

IBM CAD/Plus uses an add-on front-end access system for configuration and launching the actual CAD program. Once you are in the program, the main menu will lead you to any of a dozen or so working menus. Most of the time, everything you need will be in the "draw" menu. You choose symbols (and some options) from text-based pop-up lists. Unlike most of the other products in this story, the interface has no graphics; everything is text-based.

Despite the lack of a graphical user interface, however, you'll still find IBM CAD/Plus a very competent drafting system. The program has a wide variety of commands and enough variations of each command to make its context-sensitive help system invaluable. When executing a command, the program will dynamically highlight eligible entities as the cursor comes near them. Thus it is smart enough to know that lines can be filleted, yet text cannot. Even with very large drawings, the program is able to dynamically highlight entities with little or no perceivable delay.



IBM CAD/Plus is one of the few products with a text-based user interface, and its color palette is limited to 16 colors.

IBM CAD/Plus includes a system for creating 3-D projections from orthographic views. For typical mechanical parts, this system works well. IBM CAD/Plus creates 3-D projections using a method similar to that used in manual drafting, so designers who have a lot of time on the

board should be very comfortable with the program.

IBM CAD/Plus also includes a very good dimensioning system: It's flexible enough to do both architectural and mechanical style dimensions. The program's extensive symbol library includes ANSI Y14.5M geometric tolerancing symbols, as well as a healthy assortment of architectural, drafting, electrical, HVAC, mechanical PCB, piping, and welding symbols. The program also comes with a special-purpose library of computer-room symbols. As you might guess, this particular library does not include any symbols for plug-compatible main-

SUITABILITY TO TASK

IBM CAD/Plus, Version 3.0.1

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	●	○
Mechanical drafting	●	●	●	○
Workgroup drafting	●	●	●	○
Facilities management	●	●	●	○

frames. But for an IBM mainframe shop, this library could easily justify the cost of the program.

INTRUSIVE INTERFACE

Even though IBM CAD/Plus is a very good 2-D drafting program, its interface gets in the way too often—not in big ways, but in subtle and aggravating ways. Numeric values have to be keyed in, even though it might be easier to select a distance from existing geometry on the screen. When entering a symbol without first selecting a symbol file, an error message directs you to go back through two

GRAPHICS
2-D Drafting

► **S U M M A R Y O F F E A T U R E S**

2-D Drafting Software



Products listed in alphabetical order

■ = YES □ = NO

	AutoCAD	AutoCAD Extension for Windows	Cadkey 5	Cadvance	Cadvance for Windows	DataCAD	
List price	\$3,500.00	\$99.00	\$3,495.00	\$1,995.00	\$1,995.00	\$2,995.00	
Operating environment	DOS	Microsoft Windows	DOS	DOS	Microsoft Windows	DOS	
General							
Hard disk space required	11MB-26MB	7MB-20MB	15MB-20MB	3MB	5MB	3MB-6.5MB	
Network support:							
Can be run from server	■	■	□	■	■	■	
File locking/Layer locking	■ ■	■ ■	■ □	■ □	■ □	□ □	
File interchange (reads/writes):							
.DXF (latest AutoCAD version read)	Release 12	Release 11	Release 11	Release 11	Release 11	Release 12	
.DXF (latest AutoCAD version written)	Release 12	Release 11	Release 11	Release 10	Release 10	Release 12	
IGES (reads/writes)	□ ■	□ ■	■ ■	□ □	□ □	□ □	
Cost of required utility	Included	Included	\$295	N/A	N/A	N/A	
Other platforms supported	Sun, Digital, HP, IBM RS/6000, IRIS, SGI	Sun, Digital, HP, IBM RS/6000, IRIS, SGI	Digital, SGI, Sun	None	None	None	
Workspace Management							
Entity controls:							
Circular/rectangular arrays	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
Cut, copy, paste	■	■	■	□	■	■	
Hide entities/Lock entities	■ ■	■ ■	■ □	□ □	□ □	■ ■	
Move with rubber-banding	■	■	■	■	■	■	
Named objects	■	■	□	□	□	■	
Layers:							
Explode to other layers	■	■	■	□	□	■	
Hide layers/Lock layers	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	
Layer color	■	■	■	■	■	■	
Move objects between layers	■	■	■	■	■	■	
Maximum number of layers	Unlimited	Unlimited	256	255	255	1,000	
Named layers	■	■	■	■	■	■	
Pan/Scroll	■ □	■ □	■ □	■ ■	■ ■	■ ■	
Select:							
By entity/By entity type	■ ■	■ ■	■ ■	■ □	■ □	■ □	
By logical condition	■	■	□	□	□	□	
Last object	■	■	□	□	■	□	
Zoom:							
Dynamic zoom/Zoom window	■ ■	■ ■	□ ■	□ ■	□ ■	□ ■	
Zoom all/Zoom extents	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
Zoom previous/Zoom by factor	■ ■	■ ■	■ ■	□ ■	■ ■	■ ■	
Long drawing names/Drawing libraries	□ ■	□ ■	□ ■	□ □	□ □	□ ■	
Background redraw	□	□	□	□	□ ■	□	
Interruptible redraw	■	■	■	■	■	■	
Multiple simultaneous open windows	□	□	■	□	■	□	
Save named views	■	■	■	■	■	■	
Undo	■	■	■ *	□	□	■ *	
Programmability:							
Screen menus/Tablet menus	■ ■	■ ■	■ ■	■ ■	■ ■	□ ■	
Interpreted command scripts	■	■	■	■	□	□	
Compiled command scripts	□	□	■	□	■	■	
Link external program routines	■	■	■	□	■	□	
Shell to DOS	■	N/A	■	■	N/A	□	

N/A—Not applicable. The product does not have this feature

* Limited functions

GRAPHICS 2-D Drafting

CONTINUES

DesignCAD 2D	Drafix CAD Ultra	Drafix Windows CAD	Drawbase 2000	EasyCAD 2
\$349.00	\$395.00	\$695.00	\$2,200.00	\$199.00
DOS	DOS	Microsoft Windows	DOS	DOS

2MB-3MB	4.5MB-6.5MB	5MB	7MB	2MB
■	■	■	■	■
□□	■□	■□	■□	□□
Release 11	Release 11	Release 12	Release 12	Release 12
Release 11	Release 11	Release 12	Release 12	Release 12
■□	■□	■□	□□	□□
Included	\$195	Included	N/A	N/A
None	None	None	None	None

■□	□□	■□	■□	■□
■	□	■	■	■
■□	■□	■□	■□	□□
■	□	■	■	□
□	□	□	■	□
■	□	□	■	■
■□	■□	■□	■□	■□
■	□	■	■	□
■	■	■	■	■
64	256	256	256	256
■	■	■	■	□
■□	■□	■□	■□	■□
■□	■□	■□	■□	■□
■	■	■	■	■
□	■	■	■	■
□■	□■	□■	□■	□■
■□	■□	■□	■□	■□
□■	□■	□■	□■	□■
□■	□■	□■	□■	□■
□	□	■	□	□
■	■	□	■	■
■	□	■	□	□
■	■	■	■	■
■	□	■	■	■
■□	□■	■□	□■	■□
■	□	■	■	■
■	□	□	■	■
■	□	□	■	□
□	□	N/A	■	■

other menus to enter the name, rather than accepting it at that point. Even error messages are aggravating. They require a keystroke on the keyboard; the mouse will not do. While none of these things stop a neophyte from using IBM CAD/Plus, they do make it a little more painful than it needs to be.

While inconsistencies in a CAD program's interface can be frustrating, they could be forgiven if the program allowed you to draw what you wanted. Too often,

With practice, it's possible to get good results with IBM CAD/Plus. For the most part, however, it involves doing things the way the program wants—not the way you want.

IBM CAD/Plus doesn't. During testing, we were regularly able to make arc-to-arc trims and crosshatches of complex areas fail. With some fiddling around, I could make the arc-to-arc trims work. But we were never able to make some of the more complex crosshatches come out correctly. Furthermore, IBM CAD/Plus's context-sensitive selection of objects can be a little too picky; at times, it won't allow you to select what should be legitimate objects for editing.

Another restriction of IBM CAD/Plus is its limitation of 16,200 entities per drawing: How serious this limitation is for you depends upon the complexity of your designs.

With practice, it is possible to get good results with IBM CAD/Plus. For the most part, it involves doing things the way the program wants, rather than the way you want. Ten years ago, that kind of compromise would have been just fine. Back then, it was a neat trick to find a CAD program that could even complete a real-world drawing; the way it did it was immaterial. Today, just about any CAD program can create even the toughest 2-D drawing. Good CAD programs make the process painless.

GRAPHICS 2-D Drafting

SUMMARY OF FEATURES

	FastCAD	Generic CADD	IBM CAD/Plus	Micro Cadam Plus	MicroStation PC
List price	\$795.00	\$495.00	\$2,295.00	\$3,995.00	\$3,450.00
Operating environment	DOS	DOS	DOS and OS/2	DOS	DOS
General					
Hard disk space required	2MB	2MB-9MB	12MB-100MB	7MB-10MB	12MB-24MB
Network support					
Can be run from server	■	■	■	■	■
File locking/Layer locking	□□	□□	■□	■□	■□
File interchange (reads/writes)					
DXF (latest AutoCAD version read)	Release 12	Release 12	Release 12	Release 12	Release 12
DXF (latest AutoCAD version written)	Release 12	Release 12	Release 12	Release 12	N/A
IGES (reads/writes)	□□	□□	■□	□□	■□
Cost of required utility	N/A	N/A	\$714	N/A	\$1,295
Other platforms supported	None	Macintosh	None	IBM RS, 6000, Sun	Digital, HP, Intergraph, Macintosh, Sun
Workspace Management					
Entity controls					
Circular/rectangular arrays	■□	■□	■□	□□	■□
Cut, copy, paste	■	■	■	■	■
Hide entities/Lock entities	□□	□□	■□	■□	■□
Move with rubber-banding	■	■	■	□	■
Named objects	□	□	■	■	■
Layers					
Explode to other layers	■	■	■	■	■
Hide layers/Lock layers	■□	■□	■□	■□	■□
Layer color	□	□	■	■	■
Move objects between layers	■	■	■	■	■
Maximum number of layers	256	256	64,000	20	16,000
Named layers	□	■	■	■	■
Pan/Scroll	■□	■□	■□	■	■□
Select					
By entity/By entity type	■□	■□	■□	■	■□
By logical condition	■	■	■	■	■
Last object	■	■	■	■	■
Zoom					
Dynamic zoom, Zoom window	□■	■□	■□	□■	□■
Zoom all, Zoom extents	■□	■□	■□	■□	■□
Zoom previous/Zoom by factor	■□	■□	■□	□■	■□
Long drawing names/Drawing libraries	□■	□■	□■	■□	□■
Background redraw	■	■	■	■	■
Interruptible redraw	■	■	■	■	■
Multiple simultaneous open windows	■	■	□	■	■
Save named views	■	■	■	■	■
Undo	■	■	■	■**	■
Programmability					
Screen menus/Tablet menus	■□	■□	■□	□□	■□
Interpreted command scripts	■	■	■	■	■
Compiled command scripts	■	■	□	■	■
Link external program routines	■	■	■	■	■
Shell to DOS	■	■	■	□	■

GRAPHICS

2-D Drafting

CONTINUES

Point Line Professional 2-D CAD	SilverScreen Professional Edition	TurboCAD	VersaCAD Design	VersaCAD/386
\$2,000.00	\$995.00	\$149.95	\$595.00	\$3,495.00
DOS	DOS	DOS	DOS	DOS
4MB	5MB	2MB	2.3MB	13MB
■	■	■	□	■
□□	□□	□□	□■	■
Release 11	Release 11	Release 12	Release 10	Release 10
Release 11	Release 11	Release 12	Release 10	Release 10
□■	■	□□	□□	■
Included	Included	N/A	N/A	Included
None	None	None	Macintosh, Sun	Macintosh, Sun

■	■	■	■	■
□	□	□	■	■
■	■	□□	■	■
■	□	■	■	■
■	■	□	■	■
■	■	■	□	□
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
128	RAM-dependent	256	250	250
■	■	□	□	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
□	■	□	■	■
□	■	□	■	■
■	■	□■	■	■
■	■	■	■	■
■	■	□□	□□	□□
□■	■	□■	□□	□□
□	□	□	■	■
■	■	■	■	■
□	■	■	□	□
■	■	□	■	■
□	■	■	■	■
■	■	■	■	■
■	■	□□	■	■
■	□	■	■	■
□	■	□	■	■
□	■	□	■	■
■	■	□	■	■

FACT FILE

IBM CAD/Plus, Version 3.0.1

*Cadam Inc., 1935 N. Buena Vista Dr.,
Burbank, CA 91504; 818-841-9470;
fax, 818-840-8428*

List price: \$2,295.

Requires: 286-based PC or better, 640K RAM, EGA display or better, DOS 4.0 or OS/2 1.2 or later, mouse. 486-based PC, 4MB RAM (DOS) or 8MB RAM (OS/2), 12MB hard disk space recommended.

In short: Cadam's IBM CAD/Plus, Version 3.0.1, can do everything that you would like it to do, but it is also too quirky and ill-designed for so high-priced a package.



Ultimately, IBM CAD/Plus doesn't make a lot of sense for most users. At \$2,295 in its full incarnation, it is a very expensive 2-D drafting program. The program's biggest selling point is its strong ties to IBM's CAD products for other platforms. And IBM CAD/Plus on a PC (or PS/2) is a lot more economical for 2-D drafting than Catia or Cadam on a mainframe. If IBM cleaned up its balky interface and quirky operation and sold it for about a tenth of the current price, you might even find IBM CAD/Plus a great deal. Stranger things have certainly happened. As it is, IBM CAD/Plus seems to be the forgotten product in IBM's catalog of CAD programs. And that's too bad.

Cadam Inc.

Micro Cadam Plus

BY BRYAN M. WINTER

Micro Cadam Plus (\$3,995), a slightly trimmed-down version of the mainframe edition, is a downsizing by one of the perennial leaders in the CAD field, Cadam (an IBM Corp. company). With a large installed U.S. customer base in Fortune 100 companies, mainframe Cadam represents a formidable force in the CAD market. These days of portability and flexibility, however, demand more adaptable solutions. With the recent divestiture of Cadam's mainframe operations, the company is poised to concentrate on developing the PC market (and soon the Sun market).

GRAPHICS 2-D Drafting

SUMMARY OF FEATURES

Product: 						
☒ - YES ☐ - NO	AutoCAD	AutoCAD Extension for Windows	Cadkey 5	Cadvance	Cadvance for Windows	DataCAD
Drafting Tools						
Double lines	☒	☒	☐	☒	☒	☒
Entity by equation	☐	☐	☐	☐	☒	☐
Snaps						
Center/Midpoint	☒	☒	☒	☐	☒	☒
Circle quadrant/tangent	☒	☒	☐	☐	☒	☒
Nearest point/perpendicular	☒	☒	☐	☒	☒	☒
Chamfers	☒	☒	☒	☒	☒	☒
3-D modeler	Included	☐	Included	Included	Included	Included
Render quality	Draft	N/A	Photo-realistic	Draft	Draft	Draft
Measurement						
Associative dimensioning	☒	☒	☒	☐	☐	☒
Single/chained/baseline dimensioning	☒	☒	☒	☒	☒	☒
Tolerances	☒	☒	☒	☒	☒	☒
Rectangular/polar coordinates	☒	☒	☐	☒	☒	☒
Isometric grid	☒	☒	☐	☐	☐	☐
Separate horizontal and vertical grid increments	☒	☒	☒	☒	☒	☐
Measure angle	☒	☒	☒	☐	☐	☒
Measure area/perimeter	☒	☒	☒	☐	☐	☒
Assign attributes to symbols	☒	☒	☐	☒	☒	☒
Generate bill of materials	☒	☒	☐	☒	☒	☒
Data files (read/write)						
ASCII	☐	☒	☒	☐	☐	☒
WK1	☐	☐	☐	☐	☐	☐
DDE	☒	☐	☐	☒	☒	☐
Annotation						
Create or import hatch patterns	☒	☒	☒	☒	☒	☒
Solid fills	☒	☒	☒	☐	☐	☐
Text annotation						
Edit existing text/Built-in text editor	☐	☐	☒	☒	☒	☒
Import ASCII text files	☒	☒	☒	☒	☐	☒
Word-wrap text	☐	☐	☐	☐	☐	☐
Number of included typefaces	43	28	2	11	17	18
Device Support						
Printing options						
Background printing	☐	☒	☒	☐	☒	☒
By attributes	☒	☒	☒	☐	☐	☐
Fit to page	☒	☒	☒	☒	☒	☒
Multiple copies	☒	☒	☒	☒	☒	☐
Print preview	☒	☐	☐	☐	☐	☐
Selected layers/window	☐	☐	☒	☒	☒	☒
Variable dimensioning	☐	☐	☒	☐	☐	☒
Variable sizing	☒	☒	☒	☐	☐	☒
Documentation and Support						
On-line help	☒	☒	☒	☒	☒	☐
Technical support hours (eastern time)	For dealers only	For dealers only	8:00-7:00 M-Th, 8:00-5:00 F	10:00-8:00 M-F	10:00-8:00 M-F	8:00-7:00 M-Th, 8:00-5:00 F
BBS	CompuServe	CompuServe	Company-run, CompuServe	CompuServe	CompuServe	Company-run

N/A: Not Applicable

GRAPHICS 2-D Drafting

CONTINUES

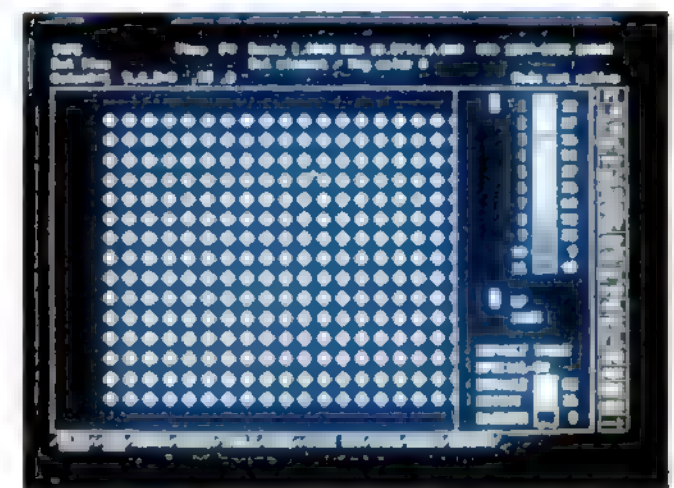
DesignCAD 2D	Drafix CAD Ultra	Drafix Windows CAD	Drawbase 2000	EasyCAD 2
☐	☒	☒	☒	☐
☒	☐	☒	☒	☐
☒	☒	☒	☒	☒
☐	☒	☒	☐	☒
☒	☒	☒	☒	☒
☒	☒	☒	☒	☒
Extra cost	None	None	Extra cost	None
Draft	N/A	N/A	Draft	N/A
☒	☒	☒	☒	☒
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☒	☐	☒	☒	☐
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20	19	19	10	5
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☒	☐	☒	☒	☒
10:00-8:00 M-F	9:00-7:00 M-F	9:00-7:00 M-F	10:00-8:00 M-F	10:30-7:00 M-F
Company-run	CompuServe	CompuServe	Company-run	CompuServe

One of the most important things about Micro Cadam is not what it can do, but what it can do it with. The drawing file system is seamless across platforms, even to the point of providing utilities within the DOS environment for reading Unix disks. DOS users unaccustomed to Unix will, however, get a surprise when the computer is "invaded" by hidden files that make up the Unix-compatible file structure within DOS.

Installing the package is relatively easy, but the hardware key protection proves to be an annoyance. In our tests, we ran the mouse through the serial key, as recommended in the manual, but found that the system would only boot about half the time. When the mouse was unplugged, however, the system booted consistently.

Manuals are abundant, but they merely explore the commands. There is a pressing need for tutorials of some depth that can review the package for the novice user. Those used to digitizer command menus will have to learn to program, since no tablet menus are available in the base package. Otherwise, the drivers cover a range of equipment that should satisfy the needs of most setups.

The guts of any CAD package are the



The color-selection menu is one of the few menus available in the Micro Cadam Plus package. It supports up to 64 colors.

geometric construction commands. In this category, Cadam offers a range of options and several ways to create an object, which can greatly reduce drawing time. Lines, as an example, are traditionally thought of as two connected endpoints. Micro Cadam, on the other hand, lets you specify a line by indicating a midpoint, then indicating direction and length; this alternate thinking can help when creating a drawing.

Other tools include leader notes, par-

The power to move
Not to mention



ve mountains. the CEO.

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Feature Model	Processor/ Speed	Hard Drive	Memory	Integrated Front Audio Panel
M57 386 SLC™	386 SLC 20 MHz	160MB	8MB expandable to 16MB	Yes
M57 486SLC2	486SLC2 50/25 MHz	212MB	8MB expandable to 16MB	Yes
DV M57 486SLC2	486SLC2 50/25 MHz	212MB	8MB expandable to 16MB	Yes
M77 486	486 SX 33 MHz	212MB	8MB expandable to 32MB	Yes
M77 486DX2	486DX2 66/33 MHz	212MB	8MB expandable to 32MB	Yes

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GRAPHICS **2-D Drafting**

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO

	FastCAD	Generic CADD	IBM CAD/Plus	Micro Cadam Plus	MicroStation PC
Drafting Tools					
Double lines	□	■	■	□	■
Entity by equation	□	□	■	■	■
Snaps					
Center/Midpoint	■ ■	■ ■	■ ■	■ ■	■ ■
Circle quadrant/tangent	■ ■	■ ■	■ ■	■ ■	■ ■
Nearest point/perpendicular	■ ■	■ ■	■ ■	■ ■	■ ■
Chamfers	■	■	■	■	■
3-D modeler	Extra cost	Extra cost	None	Extra cost	Included
Render quality	Photo-realistic	Draft	N/A	Draft	Draft
Measurement					
Associative dimensioning	■	■	■	■	■
Single/chained/baseline dimensioning	■ ■ ■	■ ■ ■	■ ■ □	□ □ ■	■ ■ ■
Tolerances	□	■	■	■	■
Rectangular/polar coordinates	■ ■	■ ■	■ ■	■ □	■ ■
Isometric grid	■	□	■	□	■
Separate horizontal and vertical grid increments	■	■	■	■	■
Measure angle	■	■	■	■	■
Measure area, per meter	■ □	■ ■	■ ■	■ ■	■ ■
Assign attributes to symbols	□	■	■	■	■
Generate bill of materials	□	■	□	□	■
Data files (read/write):					
ASCII	□ □	■ ■	■ ■	□ □	■ □
.WK1	□ □	■ ■	□ □	□ □	□ □
DBF	□ □	□ □	□ □	□ □	■ ■
Annotation					
Create or import hatch patterns	■	■	■	□	■
Solid fills	■	■	■	■	■
Text annotation:					
Edit existing text/Built-in text editor	■ ■	■ ■	■ ■	■ ■	■ ■
Import ASCII text files	—	■	■	□	■
Word-wrap text	□	□	□	■	■
Number of included typefaces	5	37	54	1	Over 100
Device Support					
Printing options					
Background printing	□	□	□	■	□
By attributes	□	■	□	□	□
Fit to page	■	■	■	■	■
Multiple copies	■	■	□	□	■
Print preview	□	■	■	■	■
Selected layers/window	■ ■	■ ■	■ ■	■ □	■ ■
Variable dimensioning	■	■	■	□	□
Variable sizing	■	■	■	□	□
Documentation and Support					
On-line help	■	■	■	□	■
Technical support hours (eastern time)	10:30-7:00 M-F	10:00-9:00 M-F	10:30-7:00 M-F	11:00-8:00 M-F	8:30-5:15 M-F
BBS	CompuServe	CompuServe, GENIE, BIX	Company-run, CompuServe	Company-run	Company-run, CompuServe

N/A—Not applicable. The product does not have this feature.

GRAPHICS 2-D Drafting

ENDS

Point Line Professional 2-D CADD	SilverScreen Professional Edition	TurboCAD	VersaCAD Design	VersaCAD/386
■	■	■	■	■
■	■	□	■	■
■ ■	■ ■	■ ■	■ ■	■ ■
□ □	□ ■	□ ■	■ ■	■ ■
■ □	□ ■	■ ■	■ ■	■ ■
■	■	□	■	■
Extra cost	Included	None	None	Included
Photo-realistic	Photo-realistic	N/A	N/A	Draft
■	■	■	■	■
■ ■ ■	■ ■ □	■ □ □	■ ■ ■	■ ■ ■
■	■	□	■	■
■ ■	■ ■	□ □	■ ■	■ ■
□	■	□	□	□
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■ ■	■ ■	■ □	■ □	■ □
■	■	□	■	■
□	□	□	□	□
2	5	9	13	13
■	□	□	■	■
■	■	□	□	□
■	■	□	■	■
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■ □	□ ■	■ □	■ ■	■ ■
□	□	□	■	■
■	□	□	■	■
□	■	■	■	■
10:30-7:30 M-F	9:00-6:00 M-F	11:00-7:00 M-F	8:30-5:00 M-F	8:30-5:00 M-F
Company-run	None	Company-run	Company-run	Company-run

allel line construction, and basic symbol libraries. The focus on engineering is made evident by commands such as rivet construction and the electrical wiring tools. These tools are good for manufacturing concerns and electrical engineers, but they find limited use in a general market.

The general features are adequate, but Micro Cadam's drafting does little to distinguish itself from the pack. One serious drawback is its limited number of layers; this was a surmountable problem in

SUITABILITY TO TASK

Micro Cadam Plus, Version 1, Release 5

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	○	○
Mechanical drafting	●	●	●	○
Workgroup drafting	●	●	●	○
Facilities management	N/A			

our test floor plan, but makes the package less than ideal for creating complex architectural drawings. You can use overlays to compensate for this deficiency, but that's not much of a solution.

With a customer base comprised primarily of engineers and technical drafters, there has been little need for any text styles other than the single basic block font the package provides in several different language and style permutations. This puts Micro Cadam at a big disadvantage in markets like architecture, where competing packages often have more font styles. Hatching styles are sufficient for ANSI-type drafting, but more styles would be appreciated by other professions. Its associative dimensioning is easy to use, but more control over output format would be useful. One important weakness is the lack of an undo command.

PC-TYPE FRONT END

The Data Manager utility gives the interface a more PC-compatible front end and goes a long way to appease users who are moving up from less sophisticated PC software. Although Data Manager does not launch into drawings, it is a start toward what the interface could be. The menu structure has nongraphic command entry based around a side menu. Novices

■ High-Tech Design

by Jon Gabay

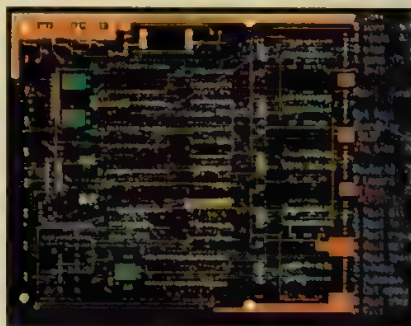
CAD software is not one-size-fits-all. Specialized fields, such as printed circuit board (PCB) design, require specialized tools. While any printed circuit board can be represented in a mechanical design and drafting program, that representation is not all that is necessary in order to go from concept to reality.

PCB design is basically a physical and spatially mechanical application. Geometric patterns are interactively manipulated until the database represents a physical layout of a target PCB. Dedicated printed circuit board programs accept input from schematic capture programs. The schematic capture program generates a *net list*, which is a data file containing all component and interconnect information: This includes information such as device type, reference designator, pin numbers, and interconnects (nets). Many capture tools are integrated into a PCB program. Popular, effective low-cost schematic capture tools are readily available from companies such as ACCEL Technologies (San Diego, California; 800-488-0680), Omatron (Richardson, Texas; 800-553-9119), OrCAD (Hillsboro, Oregon; 503-690-9891), p-cad (San Jose, California; 408-971-1300), VIEWlogic Systems (Marlboro, Massachusetts; 800-422-4660), Visionics (Santa Clara, California; 800-553-1177), and others.

In addition to schematic capture capabilities, PCB programs offer more specialized libraries and library maintenance tools. Rather than forcing the user to manually design each footprint for every component package and form factor that is required for each board, the PCB tool most likely already includes standard libraries with the component footprint. Many programs, such as ACCEL's Tango-PCB Plus (\$995), Omatron's Schema PCB (\$1,495), and PADS's PADS-PCB (\$1,500; Littleton, Massachusetts; 800-554-7253), boast comprehensive libraries of through-hole and surface-mount devices.

You can always buy footprint libraries for many design and drafting tools, but new package types and form factors mean that you'll inevitably have to design your own library elements. The PCB tools have automated this task and provide for reference designators, pin numbers, device types, pad sizes and layers, drill information, and more.

Component placement is also easier with a PCB tool. Many have auto-place information in which the net lists steer the placement of components in an algorithmically optimal way. This saves



The auto-routing tools from Router Solutions rip up existing routes if it will help to complete a route that could not otherwise be completed.

time, since you don't have to manually access each library footprint and fill in its reference designator and device type.

This placement is not always usable for a final layout, however; built-in aids such as *rats nesting*, *force vectors*, and *trace density histograms* let you quickly and easily move components around until you have an aesthetically attractive and functionally placed design. With rats nesting, for example, the program shows every interconnect; when you move components, the program shows you graphically how even and efficient your placement is.

AUTO-ROUTING

Most of the time, efficiencies derived from PCB tools stem from the effectiveness of their routers, which find paths for each net. Auto-routers use net list information to complete all routes.

Some, such as those offered by Wintek Corp. (Lafayette, Indiana; 317-742-8428), use a repertory router for regular patterns like memory chips. Others, such as those from Router Solutions (Newport Beach, California; 714-721-1017), rip up existing routes to find a path for trouble routes. All combine a variety of strategies to produce an optimal design.

Editing is almost always needed to make a board easier to manufacture. Here, the streamlined command structure of the PCB design tool lets you quickly edit, move, add, and delete traces, vias, and polygon fills.

Perhaps the best feature of PCB programs is their ability to do electrical and design rule checking, which guarantees that a board can be manufactured. Guidelines such as trace to trace, pad to trace, pad to via, and more are tested, verified, and reported on. Automated design by construction methods and router mechanical rule tests such as those in PADS-PCB and Visionics assure that the design adheres to the rules of manufacturing.

Most important, though, is the ability to verify that the physical layout represented in the design database conforms to the original schematic. Many, such as PADS and Tango, contain net list verify functions, which sequence through each net and each trace to guarantee that no shorts are present between two nets or that no unrouted or partially routed traces exist. This is extremely important, since to manually *buzz out*—the process of checking each connection—every design against a schematic is a tedious, error-prone, time-consuming, and otherwise undesirable process.

SEARCHING FOR A STANDARD

While graphics artwork used to be the standard means of generating PCB masks, today the de facto standard is the Gerber Photoplot. Here, high-resolution laser printer-like masks are generated for each layer needed to fabricate

GRAPHICS

2-D Drafting

the PCB. In addition, Numeric Control (NC) files are needed to drive the NC drilling machine, which makes all holes for vias, pads, and mounting.

The Gerber Photoplot requires that items be drawn or flashed. Pads, vias, and holes can be flashed, since these are regularly predefined patterns that can be precisely placed. Traces and text are drawn, since these follow a generally random direction from the plotter's point of view. All flashed items must have a predefined aperture for each layer. An aperture is also defined for the drawing tools.

PCB software is already set up to allow the designer to define all the flashed and drawn aperture tools. It generates reports that list how many of each type of element there are and permits a one-to-one assignment of shapes and tools. In addition, PCB tools hold the drill information for each hold. This includes absolute location as well as specified diameters. From this, PCB tools generate NC files to interface directly with the drill machine.

While mechanical design and drafting tools also allow layered representation of data, the interdependencies of each layer are more easily dealt with in PCB tools. Here, data structures are mapped efficiently for the task of PCB design. What's more, the user interfaces are more tailored to the task.

Instead of using general-purpose vector-editing tools or running predefined macros and routine calls, the menuing system of PCB tools is configured for easy transition from parts placement to photoplot output. This dramatically increases user efficiency, since the design flow is well matched to the software personality.

It is possible to do a relatively primitive PCB design using a mechanical design and drafting software package. But the dedicated PCB design software is far superior for anyone who is planning to lay out critical or numerous boards in a time-efficient manner. □

will find the command names arcane, but experienced users may find that they encourage productivity. Digitizer menus could be another solution to this problem.

The File Manager, an example of add-on and third-party support, is a Windows-like management tool that makes selecting, redlining, and translating files reasonable tasks by eliminating the need to fully enter the drawing screen. It is a good interface patch, but it cannot hide the differences (file structure, paths) that are inherent to most packages that are ported to DOS from Unix.

Although Micro Cadam can port to a larger existing environment, its network features are not what they should be. It doesn't support file locking: Two users are able to load a drawing simultaneously, although they cannot save at the same time. The imperative to have interoperability is probably the source of this weakness.

The Micro Cadam Access programming language is built around its parent product, but it costs \$750 in addition to the basic package. Access should be included for those who decide on larger installations and special uses, such as custom menu routines, parametric input (for example, screw sizes or beam specifications), and batch routines. Keeping with vertical integration among Cadam platforms, Micro Cadam's file translator gives sufficient connection to Autodesk's .DXF format, but it could benefit from integration into the larger package. Given the high price tag, it is surprising

that so many of Micro Cadam's best features are external to the main program.

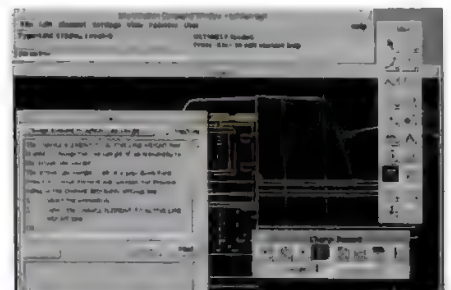
As the first attempt to bring PC interoperability to Cadam, Micro Cadam is a good product for the downsizing customer base. But as a competitor in the PC marketplace, where ease of use and cost are more important than VAR quality and support, Micro Cadam has some limitations that make it less attractive to the new buyer than many other systems currently on the market.

Intergraph Corp.

MicroStation Nexus MicroStation PC

BY EVAN YARES

You may have never heard of Intergraph Corp. Though a billion-dollar CAD company, it is not that well known among PC CAD users. It's a shame too; MicroStation PC and its Microsoft Windows-supporting sibling, MicroStation Nexus, are the kind of CAD programs that more PC users should know about. They are powerful, flexible, and even good-looking. They are also sold only by authorized MicroStation dealers and are priced at a healthy \$3,450.



Intergraph's MicroStation PC uses an OSF/Motif interface, with pull-down menus, tear-off icon palettes, and text-based context-sensitive help.

FACT FILE

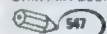
Micro Cadam Plus, Version 1, Release 5

Cadam Inc., 1935 N. Buena Vista Dr.,
Burbank, CA 91504; 818-841-9470;
fax, 818-840-8428

List price: \$3,995

Requires: 386-based PC or better, 5MB RAM, 7MB hard disk space, two monitors (EGA or better), math coprocessor, DOS 3.2 or later, mouse or digitizer. Three-button mouse recommended

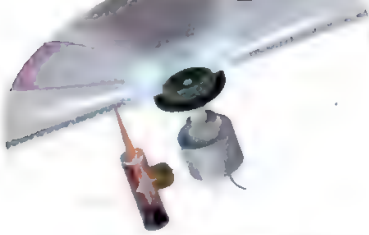
In short: Micro Cadam Plus is a capable 2-D drafting tool that works to integrate its large mainframe and Unix AIX user base seamlessly with PCs



ON READER SERVICE CARD

In the past, big CAD vendors such as Intergraph have sold only cobbled programs for use on PCs. After all, it makes no sense to scavenge sales from their higher-end products. MicroStation is different; it is a key part of Intergraph's long-term strategy. It is an appropriate CAD product for just about any discipline. The only fundamental limitations it has are in 3-D modeling, and it still does a better job in this area than most other PC programs manage. Of course, if you

See the Disk Spin.

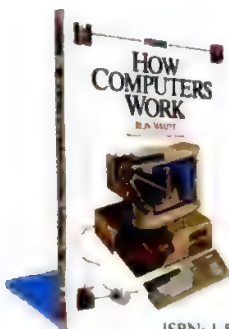


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GRAPHICS 2-D Drafting

plan to do a lot of 3-D mechanical design, Intergraph would be pleased to sell you I/EMS (\$20,000), its high-end object-oriented solid-modeling system.

The most striking visual feature of MicroStation is the OSF/Motif user interface. The user interface is exceedingly well thought out, incorporating multiple overlapping (or tiled) viewports, pull-down menus, tear-off icon palettes, and dialog boxes. MicroStation can also be run from its command line and from a digitizer tablet overlay. Although well-implemented tablet interfaces are arguably faster than graphical user interfaces (GUIs), they are losing popularity.

After working for a while in MicroStation, the screen can become somewhat cluttered with the tear-off menus and dialog boxes—a clutter common to all GUI-based systems. To increase the amount of available space, MicroStation can use two monitors and graphics cards at once (provided there are no hardware conflicts). This is an expensive solution but probably worthwhile for truly serious CAD users. We evaluated MicroStation with a VGA and an 8514/A-compatible card (and two monitors); the extra space was quite luxurious.

Although MicroStation is a 3-D program, it is very capable for 2-D drafting. It can draw just about anything you can think of, without requiring arcane incantations in the process. It comes with a wide variety of text fonts and fill patterns but includes no symbol libraries. (There are a number of third-party developers that provide these.) For architectural work, the program includes a multiline complex entity, which concurrently draws multiple parallel lines—each with an individually assignable weight, color, and pattern. MicroStation also supports B-spline curves with mathematical orders up to 15. (The order of a spline curve essentially determines its smoothness.)

MicroStation includes exceptionally good dimensioning tools. The program can be set for architectural or mechanical dimensioning—both of which are associ-

ative. For mechanical drafting, MicroStation also supports ordinate dimensioning and ANSI Y14.5M geometric tolerancing. Rather than supporting simple text-based attributes for symbols, MicroStation includes interfaces to dBASE and Oracle database files. This is more complicated than including attribute information directly in symbols, but it is also more flexible.

There are three programming interfaces in MicroStation: User Commands (UCMs), MicroStation Customer Support Library (MicroCSL), and MicroStation Development Language (MDL).

UCMs are macro-like, but they can actually be quite complex. MicroCSL is an external program library. MDL is the preferred application development environment for MicroStation, Version 4. MDL programs are written in a C-language dialect and are run directly by MicroStation.

SUITABILITY TO TASK				
MicroStation PC, Version 4.0.3				
	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	●	●
Mechanical drafting	●	●	●	●
Workgroup drafting	●	●	●	●
Facilities management	●	●	●	○

A NEW NEXUS

Last summer, Intergraph released Nexus, a free enhancement for MicroStation PC. Nexus includes four significant capabilities. The first is the ability to read AutoCAD .DWG files directly, as opposed to the previous method of reading AutoCAD drawings through the .DXF file format. While this has worked, it is even better to be able to read AutoCAD drawings directly. There are some differences in the ways AutoCAD and MicroStation represent drawing data, but Nexus makes provisions for most and gives top-notch results.

The second and probably most significant feature in Nexus is Microsoft Windows support. MicroStation is already a graphical user-interface system and when launched under Windows, it still retains its OSF/Motif flavor—but within a Microsoft-style window frame. (With a dual-screen system, the second screen is still driven directly by MicroStation.) You might call it a very elegant hack. With Nexus, MicroStation supports DDE and still runs acceptably fast.

The other two capabilities of Nexus

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2-D Drafting

are its abilities to create customized icon palettes and generate fly-throughs of 3-D models. The latter can be very interesting: MicroStation supports high-quality rendering of 3-D models with flat, smooth, or Phong shading. It also supports stereoscopic rendering.

The underlying design of MicroStation is based on Intergraph's IGDS program—a very old host-based CAD program. Somehow, MicroStation transcends its heritage. With moderate training, it is pretty easy to use. It has a few quirks, however, so it's not a good idea to jump in without some training. And MicroStation's heritage can sometimes prove limiting. The program uses a 32-bit fixed-point database, rather than the more common 64-bit floating-point database favored by programs such as AutoCAD. In some really exotic applications, 32-bit precision may not be enough, although it has proven to have enough accuracy for applications such as highway design and numerical control machining—both of which demand high precision. MicroStation also does not support fast display-list zooms and pans. MicroStation is acceptably fast as it is, but extremely large drawings can slow it down.

Using MicroStation PC or MicroStation Nexus for simple 2-D drafting is akin to entering a bulldozer in a demolition derby. It may be overkill, but they will still work just fine. Simply put, it is for those more concerned about power and flexibility than simplicity and price.



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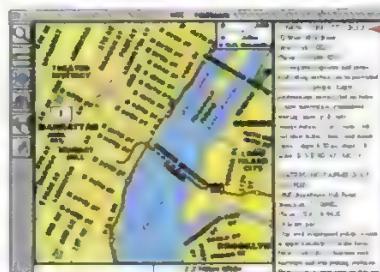
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FACT FILE

MicroStation Nexus

MicroStation PC, Version 4.0.3

Intergraph Corp.,

Huntsville, AL 35894-0001; 800-345-4856,
205-730-2000; fax: 205-730-9491

List price: \$3,450 (Nexus free to registered users)

Requires: 386-based PC or better, 2MB RAM, 12MB hard disk space, DOS 3.0 or later, VGA or better display, parallel port for hardware lock Windows 3.x required for Nexus 8MB RAM recommended

In short: A powerful all-around package that suffers only from sluggish performance on large files



ON READER SERVICE CARD

GRAPHICS 2-D Drafting

Point Line U.S.A.

Point Line Professional 2-D CADD

BY JOSEPH DESPOSITO

Point Line Professional 2-D CADD, from Point Line U.S.A., is a fast and powerful package with enough frills to take the sting out of its \$2,000 price tag. A good selection of libraries and time-saving features make this product especially suitable for creating architectural drawings.

For Point Line Professional to do its best job, however, you have to combine it with the proper hardware. The program uses multiple-level full-screen text menus and keyboard commands, for which a template is included. Point Line recommends using dual displays to avoid switching between the graphics and menu screens.

The program has a full range of 2-D capabilities for producing drawings quickly and efficiently. The point-line drawing method lets you lay down lines by clicking mouse buttons rather than by selecting a menu item. This enhances speed and accuracy. A repeat mode lets you perform repetitive functions easily, without resorting to macros. Point Line Professional also has a convenient Wall menu that allows you to create such ele-



Point Line Professional's automatic dimensioning command, 2-D CADD, lets you select two points of a line to dimension all the parts of the line at once.

ments as an arc for a bay window with minimum amount of effort.

With Point Line Professional, you can attach attributes to any symbol through a database-like entry screen. A library of architectural symbols and a drawing tablet template lets you quickly produce professional architectural drawings. Electrical symbols, unfortunately, are available only through third parties. The information can then be exported to an ASCII file. If you use a database or spreadsheet for formatting, Point Line Professional can supply the data you need for facilities management.

Some of the features are inhibited if you do not use the recommended video adapters. For example, with the ATI VGA Wonder XL board installed on our test system, the Zoom key did not function, nor did panning and scrolling.

Point Line Professional offers several special features. Automatic dimensioning allows you to add several dimensions to a vertical or horizontal section of a drawing at once simply by selecting two points that intersect all of the parts of the section. With a feature called Insert Symbol, any symbol that you place into a drawing erases the lines beneath it. In other words, you can draw a wall, and then place a window symbol right into the wall. If you want to draw at an angle, you can construct auxiliary cross hairs that temporarily adjust the angle of the x-y axes.

MAKING THE MOVE TO 3-D

Moving up to 3-D entails a significant investment. For another \$3,000, you can obtain two other modules, Professional Paint and 3D/Solids. Professional Paint is for presentation graphics; 3D/Solids is for modeling, rendering, and animation. A photo-realistic rendering product, Point Line Renderman, costs an additional \$1,000. Point Line also markets a line of "light" products. At the low end is Point Line Light-4 (\$400); at the high end is Point Line Light-16 (\$3,200). The light products include all the capabilities of Point Line Professional, Professional Paint, and 3D/Solids, but they are limited in the number of layers you can place in a drawing; Light-4 is limited to four layers. All Point Line products except Light-4 include the Point Line Access Card, which must be placed in an expansion slot of your PC. Point Line puts a chip on the

board that contains the information about the number of layers, which can range up to 128. A Toolbox Programmer's Development Kit is available for \$200. Programmers can interface to Point Line CADD products using industry standard languages such as Turbo C or Turbo Pascal.

*For Point Line
Professional to
do its best job,
you have to combine
it with the proper
hardware.*

Point Line Professional presents a formidable learning curve, partly due to the user interface, and partly due to the omission of an index in the documentation. The menus are initially confusing because mouse operation is different from keyboard operation. With the mouse, you highlight and click; with the keyboard, you enter a menu number and press Enter. Also, the menus are not as

SUITABILITY TO TASK

Point Line Professional 2-D CADD, Version 8.0

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	☒	☒	☒	☒
Mechanical drafting	☒	☒	☒	☐
Workgroup drafting	☒	☐	☐	☐
Facilities management	☒	☒	☒	☐

FACT FILE

Point Line Professional 2-D CADD, Version 8.0

Point Line U.S.A., 1636 Wilshire Blvd., 2nd floor, Los Angeles, CA 90017; 213-353-1480; fax, 213-353-1483

List price: \$2,000.

Requires: 286-based PC or better, 640K RAM, 7MB hard disk space, EGA display or better, DOS 3.1 or later, mouse. 486-based PC, 4MB RAM and extended memory manager, two monitors (Super VGA and monochrome TTL), three-button mouse recommended.

In short: Point Line U.S.A.'s Point Line Professional 2-D CADD, Version 8.0, is a fast and powerful but pricey 2-D CAD package with an upgrade path to 3-D. The user interface could stand improvement, and Point Line's Access Card will use up a slot. This is a good choice for architectural, engineering, and construction 2-D CAD needs.

 554 ON READER SERVICE CARD

clear as they could be. For example, the common term *layer* is not used in the menus, but it is used in the documentation. Finding explanations of the commands and other special nomenclature, such as key point, is tedious with no on-line help and only a table of contents to leaf through. Technical support, which is excellent, is a considerable help in mounting the learning curve. Once you learn Point Line Professional, you can move through menus with considerable speed. The program lets you enter several commands at once and jump to other menus with a keystroke.

Point Line Professional handled all of the challenges that were presented by the test drawings. Some features, like copying in a radial array, did not work as expected. The gear tooth, which was the object that was copied, needed to be placed

upright along a vertical line in order to achieve the desired results. Also, hatching became distorted when the gear was widened. Each of these problems is easily remedied, but they entail extra steps. The lone test task that the program could not do directly involved inserting a fillet between two arcs.

A couple of deficiencies in the program surfaced during the testing. The first is text; although Point Line Professional includes several fonts, all except Roman lack lowercase. Another is

the lack of an undo feature. A third is the inability to perform file or layer locking when running on a LAN. This last problem makes Point Line Professional unacceptable for workgroups that want to combine their efforts.

The only way to overlook the rather hefty price of Point Line Professional is to balance it against the extra features,

speed, and upgrade path the package offers. For architectural drawing and facilities management, Point Line Professional is a sound choice. For mechanical, electrical, and workgroup applications, however, you probably should look elsewhere.

Point Line Professional
is a sound choice for
architectural drawing
and facilities
management.

Schroff Development Corp.

SilverScreen Professional Edition

BY JOSEPH DESPOSITO

SilverScreen Professional Edition, from Schroff Development Corp., is a fine choice if you need both 2-D and 3-D CAD capabilities. For \$995, it delivers a sharp-looking interface and loads of functionality. But users interested only in 2-D drawing applications will find SilverScreen needlessly complex and lacking in amenities, such as 2-D symbol libraries.

SilverScreen's user interface is a delight. The menu is context-sensitive; all items appear on the left side of the screen and change as you make selections. This

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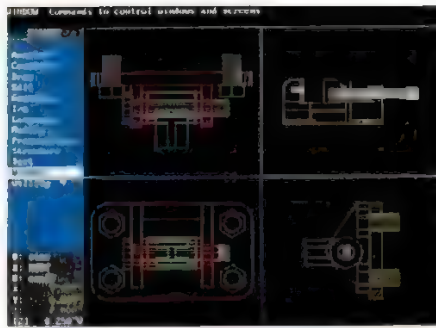
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GRAPHICS 2-D Drafting



In SilverScreen, you can divide the graphics screen into windows to display multiple views of the same drawing or different drawings simultaneously.

SUITABILITY TO TASK				
SilverScreen Professional Edition, Version 3.13				
	2-D	3-D	2-D	3-D
Architectural drafting	●	●	●	○
Mechanical drafting	●	●	●	●
Workgroup drafting	●	○	○	○
Facilities management	●	●	●	○

can be confusing at first, but you can disable it. Context-sensitive help is available for each menu item, and some items are available as keyboard commands, though a template is not included. There are also pop-up panels with "buttons" to make selections. The graphics screen can be divided into windows for multiple simultaneous views of a drawing or for displaying more than one drawing at time.

Though primarily designed for 3-D CAD and solid modeling, SilverScreen has powerful 2-D capabilities. Drawings are relatively easy to construct, thanks to menu items that let you jump to various parts of a drawing, such as the midpoint or endpoint of a line. To harness the program's power, though, you sometimes need to think in 3-D. For example, to get the radial copy command to work, you have to answer confusing prompts about the z-axis. Architects will like the ability to draw with double lines, but they will miss the inclusion of 2-D symbol libraries. Mechanical engineers will enjoy the program's ability to draw odd shapes through the use of Boolean functions and its ability to automatically draw different views of an object with the Sweep command. Electrical engineers will find the program least useful, since no symbol li-

braries are available and the 3-D aspects of the program are generally unnecessary.

SilverScreen lets you attach attributes to any symbol through a database-like entry screen, which uses both alpha and numeric fields. You can perform queries on the data and export it to an ASCII file for further processing. If you use a database or a spreadsheet for formatting, SilverScreen can supply the data that you need for facilities-management applications.

SilverScreen offers many special features. You can produce neat spirals and curves based on equations. Boolean operations let you create complex shapes easily. Besides the usual rectangular grid, SilverScreen also has circular and cylindrical grids. A ten-level undo feature is very forgiving. If you plan on stepping up to 3-D eventually, you'll find that these features serve you well in that realm, too. SilverScreen really shines in 3-D with such features as fractal drawing, lighting, and camera walk. The latter lets you take pictures of your 3-D drawing from all angles and then combine the shots into a slide show. Best of all, there is no extra charge for 3-D capability.

Also included in the base price is Sil-

verSmith, a C programming language that gives developers full access to the SilverScreen database.

Schroff markets two other versions of SilverScreen. One is Professional Edition with Renderman, which sells for \$1,995; the other is a 640K version called SilverScreen DOS, Version 2.15, which sells for \$99. This latter version comes bundled inside the textbook *Modeling for Design Using SilverScreen*. All are sold mainly through mail order, though there are SilverScreen dealers in selected areas.

STEEP LEARNING CURVE

SilverScreen is tough to learn, mostly due to the program's nomenclature and 3-D orientation. For example, the product does not use the term *layers*, but it uses *blocks* instead. So you put objects in a geometry block instead of a geometry layer and dimensions in an annotation block instead of

a dimension layer. The organization of a drawing that includes blocks and objects is similar to the DOS directory structure. Menus are filled with words such as *W-space* and *F-mesh* that do not make any sense unless you have read through the documentation. Additionally, standard drafting items have unusual names here. For example, construction lines are called temporary lines. To help you climb the learning curve, the program includes an on-screen demo that runs scripts showing you how drawings are constructed.

SilverScreen handled all the challenges of our test drawings, and in some cases it presented better ways of doing things. For example, to obtain the side view of the gear, you need not draw it; instead, you "sweep" the 2-D drawing into the third dimension or z-plane to give it depth. After doing this, you can display the side view of the gear on the screen. Some tasks, such as breaking off dimension lines, needed some creative maneuvering in order to get them to work. One test task the program could not perform directly involved inserting a

*SilverScreen handled
all the challenges
of our test drawings,
and in some
cases it presented
better ways of
doing things.*

FACT FILE

SilverScreen Professional Edition, Version 3.13

Schroff Development Corp., P.O. Box 1334,
Shawnee-Mission, KS 66222; 913-262-2664;
fax, 913-772-4936

List price: \$995.

Requires: 386-based PC or better, 4MB RAM, 5MB hard disk space, EGA display or better, DOS 3.1 or later, mouse. 486-based PC, 8MB RAM, Super VGA recommended.

In short: This package should be considered only if 3-D CAD is a likely next step; it's too complicated for basic 2-D use.



ON READER SERVICE CARD

GRAPHICS 2-D Drafting

fillet between two arcs. A common tool for 2-D drafting, rubberbanding, is missing; SilverScreen does splicing instead, which is not as capable. During testing, a bug in the program surfaced: Hatching disappeared when the drawing was saved and reloaded. A spokesperson for the company confirmed the problem and had it corrected. In general, the telephone technical support is excellent.

SilverScreen does not do file or block (layer) locking when running on a LAN. This makes SilverScreen an unacceptable choice for workgroups that want to combine their efforts on a single drawing. The ability to load a reference file, which cannot be altered, is helpful for members of a workgroup who want to view a drawing in progress.

At \$995, SilverScreen is an excellent choice for 2-D, 3-D, and solid modeling applications. If you expect to do 2-D drafting exclusively, however, SilverScreen will test your patience with its complex nomenclature and 3-D orientation. In this case, you'd be wise to look elsewhere.

International Microcomputer Software Inc.

TurboCAD

BY PAUL MURPHY

International Microcomputer Software's Release 3.0 of TurboCAD may not be all that you could ever dream of in a CAD program, but for a modest price of \$149, you will get more than enough power for most uses in a package that is quite hospitable.

Although TurboCAD's user interface has been thoroughly revamped to a more Windows-like GUI, most users expecting a truly easy-to-use package might be dis-



While some features are available from an on-screen main menu, almost all of TurboCAD's functions are accessed from drop-down menus.

appointed. While most drawing functions and mode changes can be selected from drop-down menus and drawing tools from a text-based Main menu on the right side of the drawing window, there is no visual toolbox that you might expect from a GUI interface. The Main menu is a rather inefficient throwback to the AutoCAD interface and takes up approximately 20 percent of a maximized drawing window.

Mimicking Windows' Multiple Document Interface (MDI), TurboCAD allows you to have multiple drawings open simultaneously. Drawing windows can be resized using the keyboard or mouse to allow comparative viewing of several drawings, but a fully minimized window is still larger than 25 percent of the screen area, so true tiling of four windows is impossible. Furthermore, each drawing window retains its own copy of the Main menu that takes up about 40 percent of a fully minimized window. The Main menu can be turned off, but this requires that the user rely on keyboard shortcuts for the selection of drawing tools. Even though not all commands are available by keyboard, most users will come to realize that the quickest way to work in TurboCAD is to utilize the program's extensive repertoire of shortcut keys that the company conveniently provides on a laminated reference card.

You can pan across each drawing window using Windows-like scroll bars, but zooming is accomplished using the cursor as a focal point and the Plus or Minus key on the numeric keypad as the control. There are no saved views, but drawings can be zoomed to extents or full using menus or the keyboard.

Because TurboCAD does not have a function parallel to that of the Windows Clipboard, objects cannot be copied between documents or layers without saving the object as a symbol and then importing it. TurboCAD allows up to 256 layers, but layers can't be named. And since TurboCAD supports only 16 colors, color coding is not a viable option for large drawings.

SUITABILITY TO TASK

TurboCAD, Version 3.0

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	☒	☒	☐	☐
Mechanical drafting	☒	☒	☐	☐
Workgroup drafting	☒	☐	☐	☐
Facilities management	☒	☒	☐	☐

THE OUTER LIMITS

In fact, large drawings may be TurboCAD's biggest problem, since TurboCAD's drawings have a limit of 16,000 entities. While this may be plenty of room for modest drawings, many users may find this restrictive. Several of our files for performance testing could not be imported into TurboCAD for this reason.

Despite our inability to complete the performance tests, TurboCAD felt fairly robust when regenerating a screen or creating arrays. Printing times seemed fairly quick, but a lack of printing options hurt it in this area. TurboCAD treats most printing options as hardware-specific, and in order to specify even the simplest variable in the printing process, such as printing multiple copies, you must use its Driver Editor to change the parameters on the driver itself. The Driver

*Unlike many
inexpensive CAD
programs, TurboCAD
includes a full
scripting language.*

FACT FILE

TurboCAD, Version 3.0

*International Microcomputer Software Inc.,
1938 Fourth St., San Rafael, CA 94901; 800-
833-4674, 415-454-7101; fax, 415-454-8901*

List price: \$149.95.

Requires: 640K RAM, 2MB hard disk space, EGA display or better, DOS 3.0 or later. 386-based PC and mouse recommended.

In short: If price is all that you care about, then you will be happy with TurboCAD, Version 3.0, from International Microcomputer Software; otherwise, you will find the program too limited and too difficult to use productively.



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to capturing their loyalty, one publication is a true leader.



Nothing comes close.

GRAPHICS

2-D Drafting

Editor may prove useful in editing supported drivers to fit specific unsupported models or brands, but for most users, a simple printer setup dialog will be sufficient.

TurboCAD ships with limited selections from its 17 available symbol libraries. Libraries open to full drawing windows: If four drawings are opened, no libraries can be opened, and likewise, up to three symbol libraries can be opened beside your drawing. The libraries that are provided are not very comprehensive, and most users will probably want to purchase symbol libraries from International Microcomputer Software, which will discount them when ordered in quantity.

Unlike many inexpensive CAD programs, TurboCAD includes a full scripting language. Macros can be recorded for playback, or any text editor can be used to script manually. Several scripts are provided that serve as a noninteractive tutorial that covers many aspects for those who are new to TurboCAD. This is backed up by a paper-based tutorial in the manual.

Although TurboCAD has no facilities for directly reading or writing .DBF or .WK1 files for use in spreadsheets, DBMSs, or word processors, it can write an ASCII listing of selected entities from a drawing in the form of a TurboCAD Interface File (.INT). Also included is Pascal code of a sample program that extracts data from .INT files to produce a bill of materials. Most users, however, would be better served by exporting TurboCAD drawings in .DXF format and utilizing one of the myriad of third-party programs that are available to analyze .DXF data.

While TurboCAD has a wealth of features for a product in its price range, there are a number of missing elements. For instance, while hatching is available, there is no palette of predefined hatch patterns. Hatches must be constructed each time you need them, and only lines are available for inclusion, although lines can be angled and crossed. Also, while you can apply fillets,

chamfers are not available.

While the program's attempt at Microsoft Windows emulation is at least commendable, it is not nearly as easy to use as it should be. (International Microcomputer Software is planning to release TurboCAD Pro for Windows by the time you read this. This should correct many of the flaws that we have listed, but at a higher price.) Despite its flaws, however, none of which will truly hinder CAD users who have modest needs, TurboCAD offers a rich drafting environment at an incredibly low price. The program should be seriously considered by users who are on tight budgets or by those who have hardware that does not meet the requirements of some of the high-end CAD packages.

Computervision Corp.

VersaCAD/386 VersaCAD Design

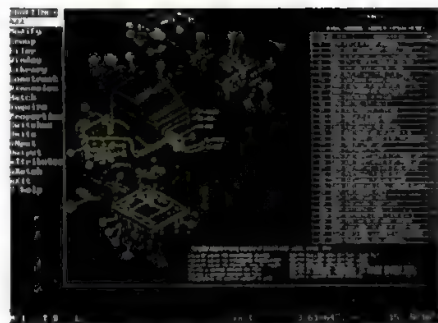
BY ROD TAYLOR

Long recognized as one of the top producers of CAD/CAM products for the DOS market, Computervision Corp. continues the tradition with the introduction of VersaCAD/386, Version 7, and VersaCAD/Design, Version 7. Whether your needs are for 2-D drafting or for 3-D design, you will find few CAD/CAM products that offer the versatility and power of these VersaCAD siblings.

As its name suggests, VersaCAD/386

(\$3,495) is designed to run in extended memory on a 386-or-higher platform. VersaCAD Design (\$1,995) offers a subset of the capabilities that are in VersaCAD/386. Both products provide 2-D drafting; 3-D design; symbol library creation and editing functions;

an isometric-view construction tool; translators for IGES, .DXF, and VersaCAD direct-file exchange; and Computervision's proprietary CAD Programming Language (CPL). Both also include a tablet menu and inserts, a keyboard overlay, and a two-volume user guide. For the budget conscious, Compu-



Though a powerful product, VersaCAD/386 uses the austere interface that is commonly found in traditional CAD packages.

tervision offers the \$595 VersaCAD Drafter, which includes the 2-D drafting/dimensioning portion of VersaCAD Design; a .DXF translator; and an output utility called VPlot.

Both VersaCAD/386 and VersaCAD Design come with a template overlay that makes the task of navigating VersaCAD's hierarchical menu system a breeze. In fact, if you're using VersaCAD for serious drafting work, you'd do well to invest in a digitizing tablet. Shorthand commands on the overlay include object-creation commands, basic construction utilities, macros, dimensioning options, and group operators.

The latest releases of VersaCAD/386 and VersaCAD/Design include more than 50 new features to complement an already-impressive arsenal of capabilities. These new features include ANSI

***TurboCAD offers users
with modest needs a
rich drafting
environment at a
low price.***

SUITABILITY TO TASK

VersaCAD/386, Version 7

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	●	○
Mechanical drafting	●	●	●	○
Workgroup drafting	●	●	●	○
Facilities management	●	●	●	○

VersaCAD Design, Version 7

	POOR	FAIR	GOOD	EXCELLENT
Architectural drafting	●	●	●	○
Mechanical drafting	●	●	●	○
Workgroup drafting	●	●	●	○
Facilities management	●	●	●	○

standard Y14.5M-1982 dimensioning and tolerancing; 16 definable object groups; dual dimensioning; and the ability to run VersaCAD 2-D, 3-D, and bill of materials under Microsoft Windows 3.x as a non-Windows application. Windows users with VGA capability can even send VersaCAD screen images to the Windows clipboard for transfer to other applications.

Both products offer improved network support, including the ability to set preferences for each user. An automatic file-locking mechanism protects drawing files that are currently in use from being edited by another user, and a network user can shell out from the current VersaCAD session to run another DOS program.

VersaCAD/386 performs screen redraws about 30 percent faster than VersaCAD Design manages. It also includes QuickRender, which permits hidden-line removal and shading of 3-D models. VersaCAD Overlay, licensed from Image Systems Technology, lets VersaCAD/386 read in raster pictures and display them on-screen as background images.

Both products use a DOS batch program as a main menu shell to control access to the eight major modules that make up the system. Files created in any one module can be transferred to any other module via this main menu shell. CPL can be used to customize these major modules to suit your specific needs.

HANDS-ON MEMORY MANAGEMENT

There are some annoying aspects to this program, however. VersaCAD's installation process requires you to enter a maximum work-file size, which in turn determines the maximum number of entities for a drawing. Since the area-fill operation required in our test floor plan generated a significant number of closely spaced lines, the work-file size had to be increased several times before the area-fill operation could be completed. Selecting too high a value for the work-file size, however, limits VersaCAD's ability to

perform other operations.

Even though Computervision assures new users that VersaCAD is an easy system to learn, navigating the programs' highly nested menu system is laborious and somewhat disorienting at times. You may have to select "Quit" from several submenus before finally returning to the main-menu level. You can write a command macro to do this automatically, but VersaCAD should do it for you.

Instead of locating global commands such as "Sketch" and "Where" at fixed locations on-screen for easy reference, VersaCAD attaches them to individual sub-

menus, making these commands harder to locate and use. This problem disappears if you run VersaCAD using a digitizing tablet, since these and many other menu commands are found on the template overlay. If you want to execute a macro without having to go through a series of keystrokes, a digitizing tablet is a must. Once a macro has been attached to the digitizing tablet overlay, you can execute it with a single click.

If you move the mouse too far in any direction, the cursor tends to disappear off the edge of the screen, and it's tough to get it to return. Fortunately, VersaCAD lets you snap the cursor to the lower-left corner of the display by simply pressing both mouse buttons.

When you select a group of entities using the "Fence" command, VersaCAD gives you no feedback as to what items were actually enclosed by the fence. You must select the "Where" command to see what you have actually picked. In addition, drawing files generated using VersaCAD tend to be quite large. For instance, the gear drawing created for this review took up about 40K of disk space in VersaCAD but only 9K when generated using Drafix CAD Ultra.

To its credit, VersaCAD can tackle design projects other CAD systems would choke on. It's been used to model entire shopping malls, processing plants, and complex mechanical components.

***VersaCAD comes
with a template
overlay that makes
navigating its
hierarchical menu
system a breeze.***

Computervision has made versions of VersaCAD that run on DOS, Sun SPARCstation, and Macintosh platforms, and VersaCAD has earned a following of over 80,000 users worldwide.

An extensive aftermarket has grown up around VersaCAD and other CAD/CAM products from Computervision. Computervision offers a third-party catalog that lists more than 100 VersaCAD-related products for the DOS platform—including fonts, macros, symbol libraries, and overlays, as well as standalone programs for performing such varied tasks as automatic corrugated-box design, photo-realistic ray tracing of VersaCAD 3-D models, and ductwork system design.

If your company has been looking for a CAD/CAM system that offers versatility and power, and you are willing to invest in the software and hardware needed to get started, then VersaCAD should meet your needs. Computervision's reputation as the leader in this field has been hard earned and is well deserved. □

FACT FILE

VersaCAD/386, Version 7

List price: \$3,495.

Requires: 386-based PC or better, DOS 3.3, EGA or better display, two monitors, 10MB hard disk space, VGA display. Digitizing tablet is recommended.

VersaCAD Design, Version 7

List price: \$1,995.

Requires: 640K RAM, DOS 3.3, EGA or better display, two monitors, 10MB hard disk space, VGA display, digitizing tablet recommended.

In short: A generally well-designed and powerful pair of products that suffer from archaic memory-management architecture. But if your company has been looking for a CAD/CAM system that offers versatility and power, and you don't mind making the investment in the software and hardware needed to get started, then the VersaCAD products should more than meet your needs. Computervision has earned a reputation as a leader in this field.

Computervision Corp.,

100 Crosby Dr.,

Bedford, MA 01730; 617-275-1800,

800-248-7728.



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ON-LINE SERVICES

Making Meaningful Connections

The mysteries of communications protocols and the Hayes command set have kept on-

line information systems outside the mainstream of users for years. But now the on-line surge into public acceptance finally seems imminent. In this review, we look at how five of the popular, general interest services—America Online, CompuServe Information Service, Delphi, GEnie, and the Prodigy Interactive Personal Service—are responding with offerings for a growing and varied audience.

The services' notoriously complex pricing structures are being made more comprehensible with each passing month. In fact, CompuServe plans to announce a new pricing plan on February 28. Moreover, the medium's ease of use (or lack thereof)—a barrier to all forms of computer communication—has seen a quantum improvement with the rise of graphical



On-line services literally network thousands of people and bring libraries of information to your keyboard. Being connected is essential, but with whom?

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by Don Steinberg

Suitability to Task: On-Line Services

These Suitability to Task ratings focus on the breadth of each service plus the cost and ease of using it. We evaluated each kind of task using the easiest access, which meant using a front end in some cases (such as CompuServe). We rated each service in five areas: e-mail, downloads, research, financial services, and home.

Under **e-mail** tasks, we evaluate how easily a user can compose, read, download, and organize e-mail messages, as well as how easily mail can be sent to users on other services. Extensive on-line help is a plus. Handling options, as well as options for sending binary attachments, faxes, telexes, and paper mail, are pertinent factors.

In the category of **downloads**, we look at the number of downloads available, balanced against the ease of finding certain shareware programs (PKZIP/PKUNZIP and LHarc). We also take into account the amount of help and information available, the options to reduce on-line time, and the availability of user-to-user help in accessing and using downloaded files.

The **research** ratings are based on the timeliness and ease of finding current and historical information on the 1992 presidential candidates. We test the features available to automate searches and downloads, as well as the availability of articles

SUITABILITY TO TASK				
Product Name				
E-mail	●	○	○	○
Downloads	●	●	○	○
Research	●	●	●	○
Finance	●	●	●	●
Home	●	●	●	●

from periodicals and government publications in full-text, abstract, and summary form.

In the area of **finance**, we evaluate the timeliness and authority (rather than the volume) of stock market quotes, company histories (both national and international), and summaries and historical information on stocks, commodities, and funds.

To evaluate a service's **home** capabilities, we determine how easily children and parents can find pen pals or identify age-appropriate and niche-interest bulletin boards. We also look for access to homework help and on-line games, as well as college, travel, and small-business information. We also consider the availability and authority of information retrieved from interactive chats and real-time support sessions.

front-ends, championed by Prodigy, America Online, and more recently, CompuServe, with its CompuServe Information Manager.

Furthermore, the critical mass of customers required to build any consumer trend is gathering. Prodigy deserves nearly all of the credit for this. Its "You Gotta Get This Thing!" national TV ad campaign defined on-line information for the American public, presenting it as a normal household utility, not something just for modem jocks.

This explains why, although the on-line industry is over a decade old, its biggest leaps occurred in the past year or so. Demographics show that 35 percent of Prodigy users are now female (compared with the industry's traditional 10 percent) and 12 percent of its users are over age 55. America Online, meanwhile, reported a stunning 40 percent increase in

membership between October 1991 and October 1992. And despite the fact that it has never been known for its ease of use, CompuServe continues to increase its membership as well, now with more than 1 million members.

ON-LINE COMMUNITIES

It follows that an increasing amount of on-line information now has nothing to do with computers. Turn on the radio and you can hear conservative talk-meister Rush Limbaugh giving his CompuServe User ID to listeners. On election day

alone, Prodigy handled 850,000 individual log-ins, many of them from users who turned to the service for election news. And Delphi, the smallest of the services reviewed here, accommodates local interests with regional reports on restaurants and entertainment events.

In many ways, on-line services are distinct communities. CompuServe has an audience that is more than 80 percent male, many of them computer professionals, while Prodigy caters to families. America Online and Delphi provide lively social forums with their interactive chat features. And GENIE stands out for its lively on-line games. As on-line services grow, we may begin to see even more diversification.

In software, the graphical-interface trend begun by Prodigy—and immediately dismissed by experts as too simple for serious users—seems to be the wave of the future. Prodigy's proprietary interface can still be slow, and the commercial nature of the service is still unacceptable to some users, but the software itself is solid and continues to improve.

America Online's graphical front-end, based on GeoWorks' software, is living proof for many that a GUI might not be so bad. Its fast, elegant interface makes tasks such as sending mail and downloading files pleasant.

Let's face it: Users who want to download a game should not need to know whether Xmodem with Cyclical Redundancy Checking is a more mathematically sound error-correcting protocol than Kermit. They should just be able to push a "download" button and get a file. And although CompuServe hasn't done much to spruce up its interface since its inception more than a decade ago, its graphical front end, the CompuServe Information Manager (CIM), makes downloads as easy as a click of the mouse in its DOS-based Version 2.0. A truly graphical Microsoft Windows version of CIM should be on the market about the time you read this review.

Our Contributors: GAYLE EHRENMAN is a staff editor of *PC Magazine*. ANGELA GUNN is a staff editor of *PC Magazine*. BARRY SIMON is a contributing editor to *PC Magazine*. ERIC BERLIN is a writer based in New York City and a former research assistant at *PC Magazine*. PRESTON GRALLA is a contributing editor to *PC Computing* magazine. DON STEINBERG is a writer based in Philadelphia, Pennsylvania. STEVEN J. VAUGHAN-NICHOLS is a contributing editor and columnist to *Computer Shopper* magazine.

CHOICES, CHOICES, CHOICES

Content is growing more interesting, too. On-line services are fascinating places to begin with: Where else can you buy Exxon stock in the same place that you discuss personal problems with strangers? But while they advertise a smorgasbord of services, they are most valuable for their specific features that meet individual users' needs. For example, CompuServe and America Online have become superb ways to obtain vendor support, unavailable elsewhere, for computer hardware and software. Users can get answers directly and quickly from company engineers and executives.

The support phenomenon has not fallen on deaf ears in the PC-publishing community either. BIX (Byte Information Exchange), which operates as a separate service from Delphi, continues to target the needs of programmers and developers. Ziff-Davis Publishing's ZiffNet provides a range of magazine-related offerings via CompuServe or Prodigy.

Prodigy, meanwhile, has built its own news organization. Members who log on at work during the day can get breaking stories before watching the 6:00 news at home. Personal financial services continue to expand as well. Electronic bill-paying and stock-buying might still seem scary for many, but other transactions—such as shopping or booking an airline ticket—are well suited to the on-line medium. And all of the on-line services offer electronic mail, implementing gateways (with varying degrees of elegance) to external e-mail systems.

Thus, on-line services are a lot like the medium they're supposedly going to replace: newspapers. Nobody reads the whole newspaper; there are people who buy it just for the comics and are happy to pay full price. Of course, price is the main difference between on-line information services and the daily paper. We're talking dollars here, not cents.

To someone who makes a living with his or her PC, the price of an on-line service is just another cost of doing business. But for the nonprofessional user, charges can mount. GENie, Prodigy, and most notably Delphi have had "flat" monthly fees for "basic" service for some time and CompuServe recently modified its pricing to offer the same. But each service



EDITORS' CHOICE

• CompuServe Information Service (with CompuServe Information Manager)

Anyone comparing on-line services could easily ask, "What's to compare?" Even pitting GENie with its healthy population of RoundTables against CompuServe and its legions of offerings is like throwing David to Goliath. But we're happy to report that,

while Goliath wins this battle, our reviews proved that the smaller challengers have much to offer.

CompuServe is clearly the Editors' Choice in this race. No other service offers the breadth and depth of offerings or puts users more in touch with such a sophisticated level of communicators. But all good things have their price, and, as of this writing, CompuServe remains one of the most expensive services in this review. While it offers a wide array of options under its standard pricing plan, its most attractive feature—its lively forums and download libraries—remain priced at the higher \$12.80 hourly rate. As we went to press, CompuServe would not release details of the new price plan it's announcing February 28, but we're hoping the plan will bring the real treasures of the service within the budgetary reach of average users.

The biggest surprise in this Editor's Choice is that CompuServe, the most complex and, at one time, the most forbidding of all services, even wins on the ease-of-use front. Not for everyone, mind you. Only for those using the CompuServe Information Manager (CIM), Version 2.0, and its sister with a graphical interface, WinCIM. If you've been accessing the service with a standard communications program and complaining that using the service is like struggling through a text adventure game, it's time to switch to CIM. No other front-end software—not even America Online's lovely graphical interface with its easy-to-use push buttons—goes so far to cut a complex communications service down to size. Off-line reading and composition of

e-mail, automatic downloads that require no knowledge of protocols, and the ability to organize a desktop of folders and automate an excursion through favorite haunts are among the many fine menu-driven functions that remove all that was once mysterious from CompuServe's stark native environment.

While its competitors have a long way to go before catching up with CompuServe, they do offer specialty options that the monolithic service lacks. Prodigy cannot be beaten for its family offerings; no on-line service is so sensitive to the needs of children or so generous in developing new options for the young and young at heart. No service has as social an aspect as America Online, with its engaging interactive chat and messaging features. In addition, its attractive interface and support for conferencing bode great potential. Even before CNN opened its forum on America Online, this small and growing service stood out as the talk-show equivalent in the on-line world.

GENie is CompuServe cut down to size, good for those who prefer to wade, rather than swim, through information. But GENie's Aladdin front-end software is not CIM, and until it does something about its old-fashioned text environment, this on-line service will remain rooted in the past. Finally, tiny Delphi offers the best buy for those simply seeking entertainment. It's another text holdover from the past and it has only a handful of chats and SIGs and a sampling of games, but if that's all you're looking for, Delphi offers it at the best price.

■ The Internet: *Access to Everywhere*

by Steven J. Vaughn-Nichols

It isn't a traditional on-line service; but a collective of computer systems known as the Internet, making up perhaps the largest unconventional on-line service in the world. Begun by the Defense Department in 1969 as a network to link research computers, the Internet now connects thousands of businesses, universities, and on-line services around the world. It offers access to numerous databases and message forums, as well as e-mail connectivity to any system on the network.

Most universities and research facilities and many companies already have Internet access. Those that don't can generally gain access to the Internet in one of two ways. For the fullest access you can connect a LAN to the Internet via a router and a dedicated 56K (or faster) line. This kind of connection starts at around \$1,500 per month and moves up from there depending on the connection speed and other factors. A far less expensive but slower method of connection is to use normal phone lines and high-speed modems (V.32 and up) using the Serial Line Internet Protocol (SLIP) or Point-to-Point Protocol (PPP).

In either case, connection to the Internet is usually made via national or regional providers like Performance Systems International (703-620-6651) or CERFnet (800-876-2373). These companies are members of the Commercial Internet Exchange (CIX), which enables its subscribers to transmit commercial data, while many sections of the network, including the US backbone, NSFNET, prohibit business traffic.

Individual users can access the Internet for as little as \$19 a month via regional providers like the Baltimore/Washington-area's Digital Express Group (301-220-2020) and Software Tool & Die's The World (617-739-0202), serving Massachusetts. Connections can be made with any standard

communications program, such as Datastorm's Procomm Plus. Although the Internet connects its users to each other in a vast, worldwide network, bound together primarily by the Transmission Control Protocol and Internet Protocol (TCP/IP), you no longer need the expert knowledge of TCP/IP and Unix that you once needed to use the service.

MAIL AND MESSAGES

Electronic mail is routed to the Internet using the Request for Comment (RFC) 822 address format. A letter sent to a user on CompuServe might be addressed 12345.678@compuserve.com, where the numerals represent the user's number on the service. Whether your e-mail account is located on CompuServe, GENie, MCI mail, USENET, The Well, or any of dozens of other systems, RFC 822 and the Internet provide a way to connect to your friends and colleagues. But because Internet mail moves from system to system, until it reaches its destination, mail can take hours to days to deliver depending on how many stops it makes before it is forwarded to its final receiver.

You can also use the Internet to locate USENET news groups, which are comprised of messages loosely bound to a single topic. Hundreds of news groups contain messages on topics from i486 assembler language to Star Trek to supermodels (Cindy Crawford, not astrophysics). These groups are equivalent to forums you'd find on on-line services or in a bulletin board's discussion groups. If more than a few hundred people in the world are interested in a topic, chances are there's a news group for it. You access the discussions in news groups using menu-driven

freeware programs called "news-readers."

DOWNLOADS AND DATA

In many ways the Internet is more like a computer network than an on-line service. For example, Telnet, a user program based on TCP/IP, lets you log in to any other computer system on the

Internet. Like commercial services, you can download files from Internet nodes using the TCP/IP's File Transfer Protocol (FTP).

The trick to navigating the Internet is knowing where to find files. In the past, you could either hunt about or find someone on-line to

tell you. Today, the freeware program Archie does the work. Archie is a client/server database program that searches the network's sites every month. Users access information with clients that support text searches.

Making the data hunt even easier are two front-end tools and a work-in-progress. Gopher is a freeware program with an easy-to-use, menu-driven interface that eases the search among online databases. If Archie is like a card-catalog of Internet files, Gopher is like an Internet librarian. For more sophisticated searches, you can turn to WAIS (pronounced "wayz"), a distributed free-text program that can search more than 300 textual databases. Some of these databases, like a version of the Dow Jones Information Services, are fee services, while others are free. Unlike CompuServe front ends, Gopher and WAIS run on the remote computer rather than on your local system. The work-in-progress is called World-Wide Web (WWW), a global attempt to organize the resources of the Internet into a hypertext searchable format. □

*Hundreds of
news groups contain
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ranging from
"Star Trek" to
Supermodels.*

defines "basic" differently, and they treat the very best stuff—like forums, financial information, or special games—as extra-fee "custom choices" (Prodigy) or "professional services" (GEnie). Users of such additional services can extend their bills beyond the flat rate to include hefty per-minute charges.

COST CONSIDERATIONS

For home users, there's another major cost beyond flat rates, even for basic service. Unless you want your home phone to be busy to callers while you're otherwise occupied, you need a second phone line, which can cost \$20 a month. Add that cost to your yearly membership fees, per-minute extended surcharges, and premium-service fees, and you may be looking at a monthly tab that equals your cable TV bill. That's hundreds of dollars a year. But people are paying the price right now—which may be the most convincing proof of all that "this on-line thing" is here to stay.

In the following articles, we put the country's top on-line computer services—America Online, CompuServe, Delphi, GEnie, and Prodigy—through their paces. We tested every aspect of each service, examining the breadth of offerings for e-mail, downloads, research, financial information, and home services, as well as how easily and inexpensively we could access them. In effect, we read the whole newspaper for each. We also tell you a bit about front-end software designed to ease and automate access to CompuServe and Prodigy and show you how to access the world's largest on-line service, the Internet. We did not include specialized services like Lexis/Nexis in our review because, although they are rich with research offerings, they offer no options for downloads, or home services.

We've looked at how the current offerings deliver on the promise of on-line information. We even have an idea of what's coming down the line in the next year or so, but what lies beyond is anybody's guess; in fact, people are probably debating it in an on-line forum right now.

America Online Inc.

America Online

BY ANGELA GUNN

America Online (AOL) is the talk radio of on-line services, comprising equal parts information and coffee klatch with a bit of showmanship. What distinguishes AOL is its highly interactive real-time chat features served up in a friendly, attractive, icon-based interface. The required front-end software comes as an application within the GeoWorks environment, and runtime versions can also be ordered from AOL.

AOL features a reasonable offering of downloads, good business and finance information, a global news feed, and comprehensive general research sections.

And newshounds will enjoy checking in with the CNN Newsroom on-line and participating in the cable television service's interactive conferences.

GOOD TALK

This service shines in its user-to-user

interaction—real-time chats and interactive "studio" presentations which feature guests from famous authors to computer game developers in a virtual on-line amphitheater. While these features can be found on other services, they are not packaged within the same attractive interface that you will find here.

A single user can create up to five separate screen identities, each with its own individual password, allowing either five members of the family to use the service or permitting the single user to create five different names for use in role-playing games and for other such practical appli-

FACT FILE

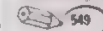
America Online

America Online Inc., 8619 Westwood Center Dr., # 200, Vienna, VA 22182-2285; 800-827-6364, 703-448-8700; fax 703-883-1509

List price: \$7.95/month (5 hours free for first month and service fee waived, 2 free hours per each additional month, \$0.10 per additional minute)

Requires: 286-based PC or better (386-based PC recommended), modem, 4MB RAM, 40MB hard disk, PCAO (PC version of American Online), Version 1.5. Windows and color monitor highly recommended

In Short: Its speedy and attractive graphical interface and outstanding chat and messaging features make America Online the liveliest service reviewed here. It offers more fun than technical expertise. But news research and financial features, SIGs, and vendor forums are growing on this young service

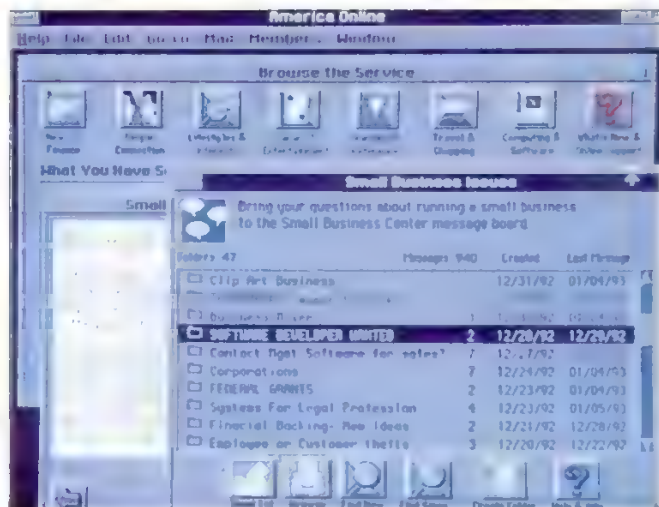


549 NATION'S SERVICE CARD

cations.

But the talk is not cheap. America Online's basic service, which includes 2 hours on-line, is \$7.95. After that, time is charged at 10 cents per minute. There is no 9,600-bit-per-second modem access. Downloads and forum access are unlimited and there is no additional charge for e-mail. America Online's menu access to its Internet gateway carries no additional fee for interservice communications, and it offers the most complete help system for sending Internet mail of all services that we reviewed for this article. The purchase of some initial software may be required in order for you to play certain in-

SUITABILITY TO TASK				
America Online				
	POOR	FAIR	GOOD	EXCELLENT
E-mail	●	●	●	○
Downloads	●	●	●	●
Research	●	●	●	○
Finance	●	●	●	●
Home	●	●	●	○



America Online's graphical interface allows you to open information windows and move them around the screen.

SOFTWARE On-Line Services

teractive games, but beyond that you pay only for connect time.

PARENTAL GUIDANCE SUGGESTED

This on-line service features a number of forums for educators in which high school students may seek help with school work, teachers and parents may swap ideas on courses and in-school programs, and in which users can even sign up for courses and participate interactively in on-line classrooms. This is not, however, a service that we would recommend for families with young children. The chat areas hold many pitfalls beyond the very real prospect of receiving an enormous bill from America Online. While the service enforces standards of good taste within chat rooms, it cannot protect users from suggestive private messages. And they do occur. The service will take action, however, and even suspend the accounts of users who are reported to be sending harassing or obscene messages.

Beyond this one drawback, American Online's wonderfully chatty, over-the-back-fence atmosphere provides an unimpeachable introduction to on-line services. Of all the services reviewed here, America Online is the most social, the one with the most appeal to the big kid in all of us.

CompuServe Inc.

CompuServe Information Service

BY BARRY SIMON

CompuServe Information Service is like a vast on-line city with many information and entertainment offerings for its sophisticated population. It has forums and databases that are quite staggering in breadth, depth, and variety. But like a large city, CompuServe can be forbidding and difficult to navigate. And, like many metropolises, CompuServe's infrastructure is old. Its native interface has barely changed since the service was founded ten years ago. Fortunately, CompuServe provides relief in its front-end software, the CompuServe Infor-

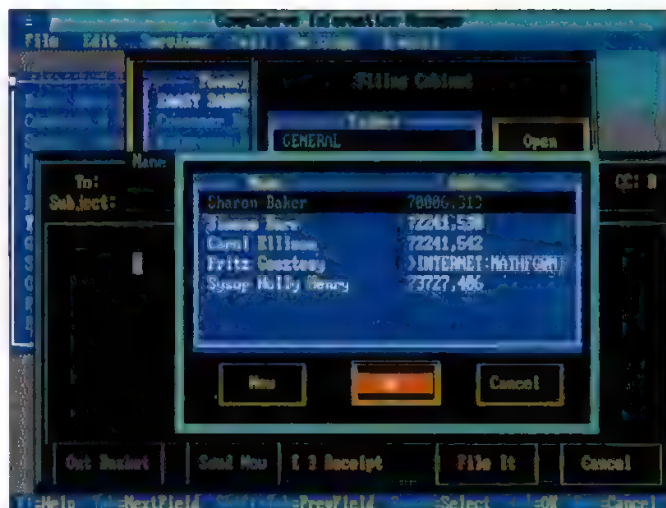
mation Manager (CIM), Version 2.0, and the company promises to extend that very same help in CIM for Microsoft Windows, which should be available for downloading by the time you read this review.

Without CIM, on-line beginners may struggle to find what they are looking for, thus wasting valuable time on-line. CompuServe has always been the most elite of on-line services, with hourly rates so high that users facetiously abbreviated CompuServe Information Services as C!\$. But here, too, CompuServe has made welcome changes. A variety of pricing plans bring basic services within reach.

OPTIONS AND PRICING

At this writing, CompuServe offered two plans—"standard pricing" at \$7.95 per month and "alternate pricing" at \$2 per month. Services not covered in the plans carried hourly charges of \$12.80 for 1,200- and 2,400-bit-per-second access and \$22.80 for 9,600-bps access. CompuServe said it will announce new pricing on February 28, significantly reducing the standard hourly charges. With the exception of e-mail, on-line functions fall into three classes: basic, extended and surcharged.

Basic functions are free with standard pricing but have normal hourly charges for alternate plan members. At this writing, forums and other extended functions carried the normal hourly rates. Surcharged services have additional hourly and/or per-item fees. You are clearly warned before accessing surcharged services and, on many, are given running costs. A few services carry minimum system wide



CompuServe Information Manager (CIM) has a multiple-window interface that allows you to view your address book while creating messages.

charges. ZiffNet forums (those associated with Ziff-Davis publications, including *PC Magazine*) carry an extra \$2.95 per month fee.

Electronic mail has its own pricing policy: 60 messages of up to 7,500 characters allowed under the standard pricing plan at the time of this writing. Alternate Plan members pay normal connect charges for reading or writing mail but no per-message or special InterNet fee.

Many users will happily restrict themselves to e-mail and the basic services, but the lure of the forums will doubtless reach many others. Forums users can ex-



EDITORS' CHOICE

FACT FILE

CompuServe Information Service

CompuServe Inc., Membership Sales, P.O. Box 20212, Columbus, OH 43220; 800-848-8199, 614-457-0802

List price: Start-up kit, including manual, \$49.95; standard service, \$7.95 a month, 1 hour of connect time, \$12.80; 1 hour of 9,600-bits-per-second access, \$22.80; ZiffNet access, \$2.95 a month, manual without kit, \$15

Requires: Modem, communications software, CompuServe Information Manager recommended

In short: CompuServe, by introducing a monthly basic fee and a version of CIM that uses a windowed environment for access to many of its services, addressed long standing complaints about its high cost and forbidding interface. It's now an extremely attractive choice



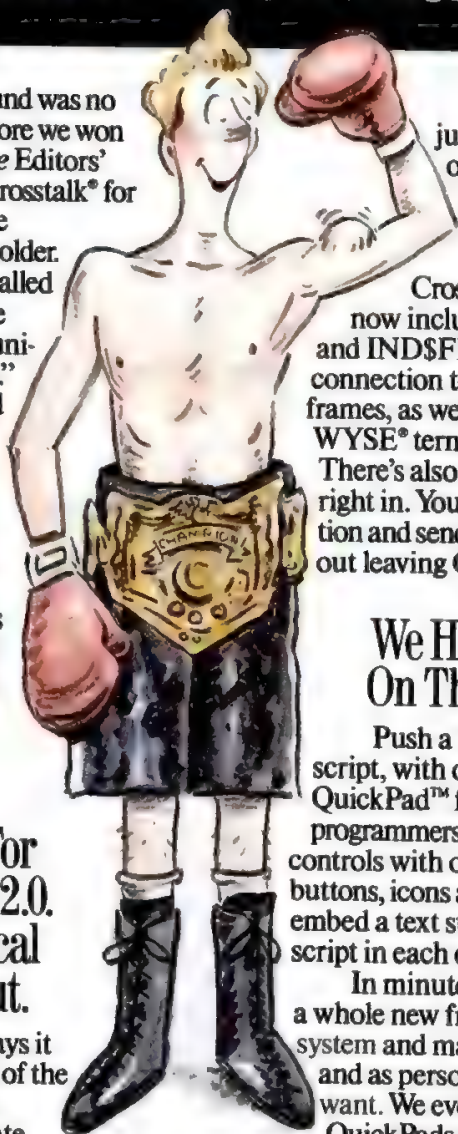
The Heavyweight Champion Of Windows Comm Software Just Became Even More Of A Knockout.

The first round was no contest. Long before we won the *PC Magazine* Editors' Choice Award, Crosstalk® for Windows was the undisputed title holder. *Software Digest* called it the "best of the graphical communications packages." *InfoWorld* named it "Product of the Year." And it won the *Windows Magazine* Readers' Choice Award.

But for all its power, we knew it had the potential to pack an even bigger wallop.

New Crosstalk For Windows 2.0. A Technical Knockout.

PC World says it "jumps far ahead of the last version" and "advances the state of the art in modem software." And you can see the difference the



But we didn't just put a new face on an old program. We also taught it a lot of new tricks. For instance, Crosstalk for Windows now includes FTTERM and IN\$FILE support for connection to IBM® mainframes, as well as HP® and WYSE® terminal emulation. There's also a text editor built right in. You can edit information and send it out again, without leaving Crosstalk.

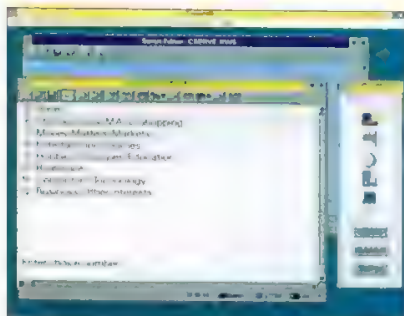
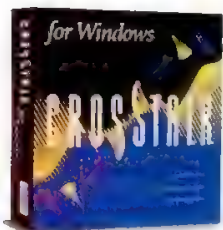
We Hit It Right On The Button.

Push a button and run a script, with our new object QuickPad™ feature. Even non-programmers can design custom controls with objects such as buttons, icons and pictures. Then embed a text string or an entire script in each object.

In minutes, you can design a whole new front end for a host system and make it as friendly—and as personalized—as you want. We even include pre-built QuickPads for accessing and navigating the major on-line services.

minute you start it up. The interface is more functional, more convenient and just downright fun to use. A new QuickBar™ tool menu turns common tasks like

downloading a file into a simple matter of clicking on an icon. And it follows Windows™ 3.1 interface standards to the letter.



Windows within Windows: QuickPads float on your screen, ready to run entire scripts at the push of a button.

CIRCLE 389 ON READER SERVICE CARD

Now's The Time For You To Get Pumped Up.

You can have multiple comm sessions running at once—working on a VAX® link while you're connected to CompuServe®, for instance. You can remap your keyboard by moving keys on a graphical keyboard layout. Just drag and drop.

Crosstalk for Windows sets the performance bar even higher for competitors in the Windows communications market.
—PC World, October 1992

You can even import dialing directories from the DOS version of Procomm Plus™. (We want to make everything easy for you, including switching to Crosstalk.)

So climb into the ring. Registered users of Crosstalk for Windows and Procomm Plus can upgrade for only \$49, by calling our toll-free number.* Go a round or two with Crosstalk for Windows 2.0, and you'll know why it's the winner and still champion. To upgrade or for more information, call

1-800-348-3221, ext. 25A.**

CROSSTALK

Another Communications Solution From DCA®

*Offer expires June 30, 1993, and is available in U.S. and Canada only. Must show proof of ownership. **If outside the U.S., call (404) 475-8380. © 1992 Digital Communications Associates, Inc. All rights reserved. DCA and Crosstalk are registered trademarks and QuickPad and QuickBar are trademarks of Digital Communications Associates, Inc. Windows is a trademark of Microsoft Corporation. All trademarks are the property of their respective owners.



pect to spend between \$10 and \$100 per month in hourly access charges depending on how well they control their on-line habits!

Newcomers to CompuServe access the service using a Membership Kit or an introductory membership booklet. The \$49.95 Membership Kit includes CIM, documentation, and a credit for the first month of standard service. The booklet is also included with many third-party software and hardware products (mostly modems and some computer systems). These products typically include \$15 of credit toward early CompuServe usage.

FRONT-END ASSISTANCE

CIM itself costs \$25, but its price includes a \$25 usage credit, so it's almost free. And without CIM, CompuServe's wide array of offerings and its stark, unhelpful character-based interface can defeat even an experienced user.

Some parts of CompuServe (for example, Eaasy Sabre's airline reservation service) have been CIMed. That is, CompuServe has made it possible to access these services using the dialog boxes and windowed menus of the CIM interface. But in some CompuServe areas, including IQuest, a premium service of many on-line databases, and Peterson's College Database, CIM drops you into the native interface.

CIM's e-mail handling allows you to collect or send mail and log off automatically. CIM keeps an address book that lets you automatically enter an addressee's name with a click of the mouse. And adding names to it is as simple as clicking on the From field while reading a mail or forum message.

You can send e-mail messages to other users on the service, MCI Mail, AT&T Mail, Interlink and Internet. You can also send faxes, telexes, and postal mail.

LIVELY FORUMS

Forums with their message sections and associated file libraries are really the jewel in CompuServe's crown. There are about 340 forums, although only about 40 are related to home and hobbies. Vendor support varies from the 20 Microsoft forums to those boutique forums that are frequented by smaller vendors. In all, about 350 computer vendors have support areas.

Navigating the Features Table

The features chart summarizes the offerings of the on-line services. Users who are evaluating these services will want to consider cost and accessibility against the number and quality of features. A service is of little value if it cannot be easily accessed. Access to local node sites, Sprintnet, or Tymnet can be as important as price, so if your access site is a toll call or long-distance charge away, large phone bills can quickly offset any savings that you might have gained by subscribing to a lesser-priced service.

Much of what is offered through on-line services is a function of user demographics. You are on-line with people you want to be in touch with. Services with larger user bases typically offer more options and livelier, timelier information. They tend to have many special interest groups and even feature international service.

Certain e-mail features such as automatic mail downloads and support for off-line composition and folders can be functions of the front-end software package or of the service itself. As we went to press, Prodigy Services was ready to market a \$7.95 option to its software that supports folders, off-line composition, and automatic mail downloads. CompuServe and GENie Service offer such features only if you use an optional front end such as CIM or Aladdin. Many of the easiest-to-use features for downloading mail are inherent in America Online and The

Message bases are usually very active—on some forums there can be 400 messages per day. Some forum libraries have hundreds of files to download, and CIM handles the chore without your having to worry about communication parameters and protocols, as you do when you log in with a communications program.

The amount of research information that you can access through CompuServe is mind-boggling. It has about 900 databases. Nine databases as well as weather and Associated Press Online are included

Prodigy Interactive Personal Service with their graphical front ends.

The number of protocols supported by a particular on-line service is important when accessing the service through standard communications programs. Those services that offer their own method of downloading and their own proprietary protocols actually have a distinct advantage over those services that do not, in that the downloads are automatically handled by the software. So, even though CompuServe supports many protocols, CIM users are shielded from protocols by the front-end software, which automatically downloads without having to specify a protocol.

On-line access to vendor support, technical expertise, research, financial and investment services, and home services can be a tremendous professional and personal asset. The features noted in this features table will provide an idea of the scope of these sorts of services.

Many on-line services offer assistance to small business owners in the form of utilities downloads and advice on taxes, business services, and marketing. On-line travel services help plan vacation and business travel.

Finally, most on-line services support their users in a variety of ways, using newsletters, magazines, customer-support 800 numbers, and real-time on-line support in the form of interactive or e-mail messages.

in the basic service plans.

IQuest, a surcharged database, has cross-database search capabilities so it will figure out where you should look for specific information. Even the simplest IQuest search, if successful, will run about \$15, and serious research there could cost several hundred dollars. But IQuest includes critical information on patents and trademarks, TRW business credit reports, rare diseases, and archival newspaper copy.

Outside of IQuest, you'll typically pay a \$15-per-hour surcharge over normal

► **S U M M A R Y O F F E A T U R E S**

CONTINUES

On-Line Services



Products listed in alphabetical order

■ = YES □ = NO

	America Online	CompuServe Information Service	Delphi	GEnie	Prodigy Interactive Personal Service
General Information					
Sign-up fee	None	None	None	None	\$49.95
Monthly fee (basic service)	\$7.95	\$7.95	\$20 (20 hours) or \$10 (4 hours); \$4 for each additional hour	\$4.95	\$14.95 (or \$155.40/year)
Hourly connect charge beyond basic service (prime time)	\$6.00	\$12.80	\$9.00 for Sprintnet or Tymnet	\$12.50	None
Hourly connect charge (other times)	\$6.00	\$12.80	None	\$6.00	None
9,600-bps charge (prime time)	N/A	\$22.80/hour	N/A	\$30.00/hour	\$2.00/month
9,600-bps charge (other times)	N/A	\$22.80/hour	N/A	\$18.00/hour	\$2.00/month
Front-end software	Required	Optional	None	Optional	Required
Interface	Graphical	Character	N/A	Character	Graphical
Number of local node sites:					
Service's own (300–2,400 bps)	None	370	2	700	565
Service's own (9,600 bps)	None	160	None	80	190
Sprintnet access	■ (not at 9,600 bps)	■	■ (not at 9,600 bps)	■	□
Tymnet access	■ (not at 9,600 bps)	■	■ (not at 9,600 bps)	□	□
800-number service	□	■	□	■	□
Number of paid accounts	200,000	1,100,000	Under 100,000	400,000	870,000
Maximum number of users per account	5	1	5	1	6
Number of countries served	1	135	60	30	1
E-Mail					
Number of messages (basic service)	Unlimited	60/month	Unlimited	Unlimited	30
Cost per additional message	N/A	7,500 characters, 15¢; each additional 2,500 characters, 5¢	N/A	N/A	25¢
Automatic mail downloads	□	■ (with CIM)	□	■ (with Aladdin)	■
Off-line composition	■	■ (with CIM)	□	■ (with Aladdin)	■
In/out baskets	■	■ (with CIM)	□	■ (with Aladdin)	■
Number of attachments permitted	1	1	1	1	Unlimited
Maximum size	Unlimited	512K	Unlimited	Unlimited	250K
Gateway/Internet messages	■	■	■	■	□
Fax	■	■	■	■	■
Telex	□	■	■	□	□
USPS	■	■	□	□	■
Receipts	■ (local only)	■	■ (faxes only)	■	□
MHS hub support	□	■	□	□	□
Downloads					
Downloads available	■	■	■	■	Optional (through ZiffNet)
Protocols supported:					
CompuServe B	□	■	□	□	□
Kermit	□	■	■	□	□

N/A—Not applicable. The product does not have this feature.

SOFTWARE
On-Line Services

SUMMARY OF FEATURES

CONTINUES

Products listed in alphabetical order

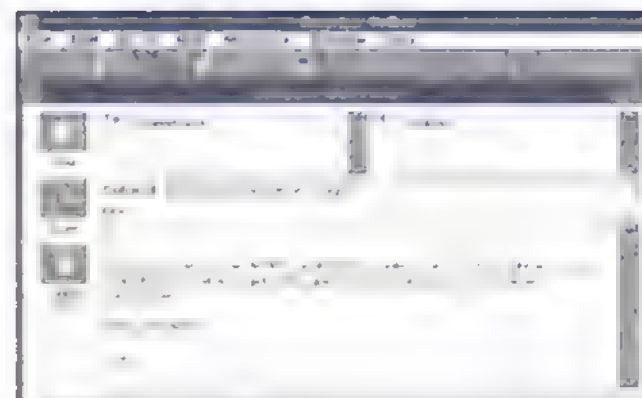
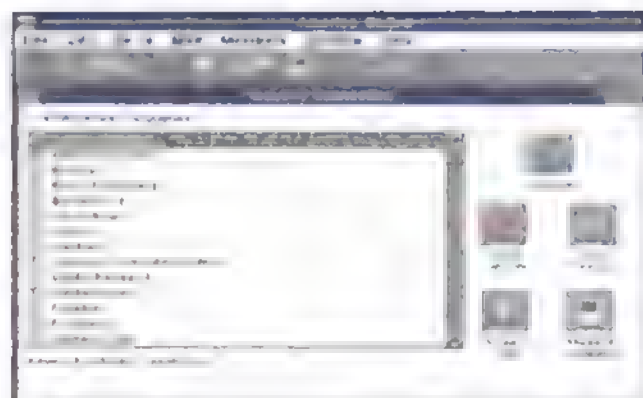
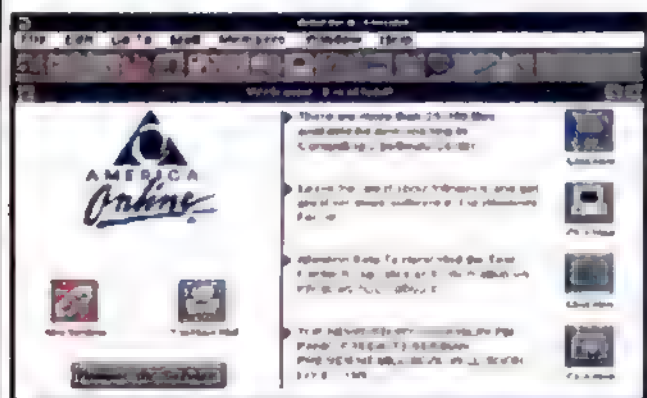
■ = YES □ = NO



	America Online	CompuServe Information Service	Delphi	GEnie	Prodigy Interactive Personal Service
Downloads (continued)					
XModem	□	■	■	■	□
YModem	□	■	■	■	□
ZModem	□	■	■	■	□
Other	1 (proprietary)	2	None	2	1 (proprietary)
Scans uploads for viruses	■	■	■	■	□
File locator	■	■	■	■	Optional
Old versions purged	■	■	■	■	Optional
Vendor and PC Support Services					
Computer companies represented	130	350	10	200	17
Vendor forums	130	185	None	35	3
Vendor software libraries	130	3,240	None	35	None
Real-time vendor conferences	■	■	□	■	□
On-line shareware registration	□	■	□	□	□
Research Services					
Information databases	More than 45	1,200	1	200	None
Databases in basic service	More than 45	9	None	5	None
Encyclopedias	2	2	2	1	1
Magazines	4	200	2	Info not available	12
Full-text	■	■	■	■	□
Newspapers	2	55	None	Info not available	None
Full-text	■	■	N/A	□	N/A
Full-text trade publications	□	■	□	■	□
Full-text government publications	□	■	□	■	■
Demographic/census data	□	■	□	■	□
News wires and sports services	1	29	3	12	1
Personal clipping service	□	Optional	□	■	□
Color weather maps	■	■	□	□	■
Can be viewed on-line	□	■	N/A	N/A	■
Local weather forecasts	□	■	■	■	■
International weather forecasts	□	■	□	■	■
Delay on sports scores	15-20 minutes	No delay	2 days	N/A	No delay
Aviation forecasts	□	■	□	□	□
Financial Services					
On-line checking	□	□	□	□	■
Brokerage services	■	■	□	■	■
Dun & Bradstreet's company profiles	■	■	□	■	□
Standard & Poor's	□	■	□	■	□
Portfolio manager	■	■	□	□	□
Stock quotes	■	■	■	■	■
Cost per quote	None	None	7¢	None	None
NYSE and American	■	■	■	■	■
Others	More than 2	3	1	Info not available	3
Mutual fund rates	□	■	□	■	■
Cost per lookup	N/A	1.5¢	N/A	None	None
Treasury fund rates	□	■	□	■	■
Cost per lookup	N/A	1.5¢	N/A	None	None

N/A—Not applicable The product does not have this feature

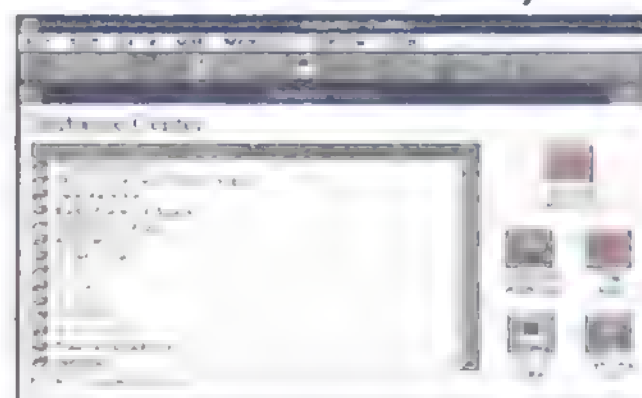
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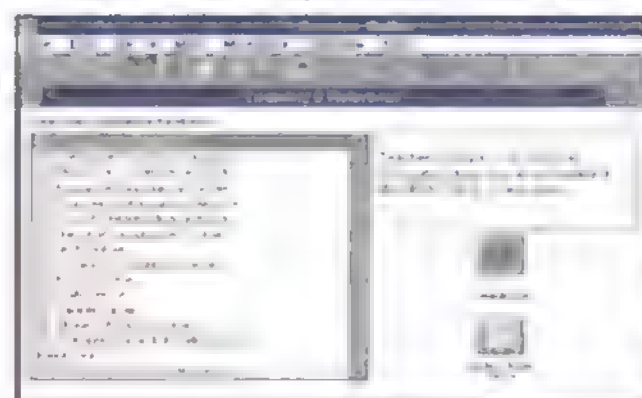
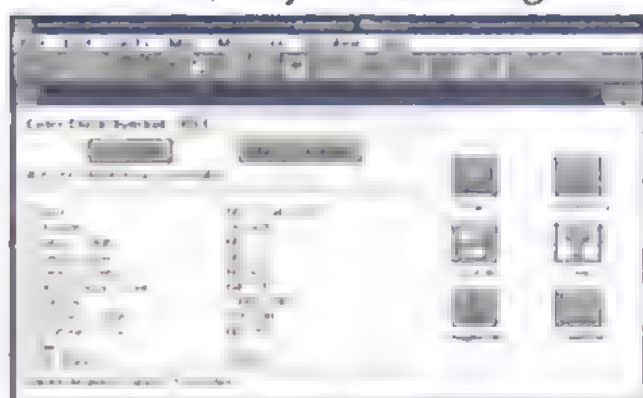
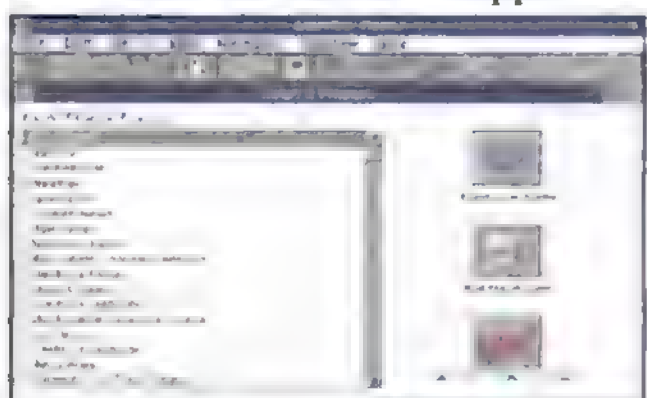
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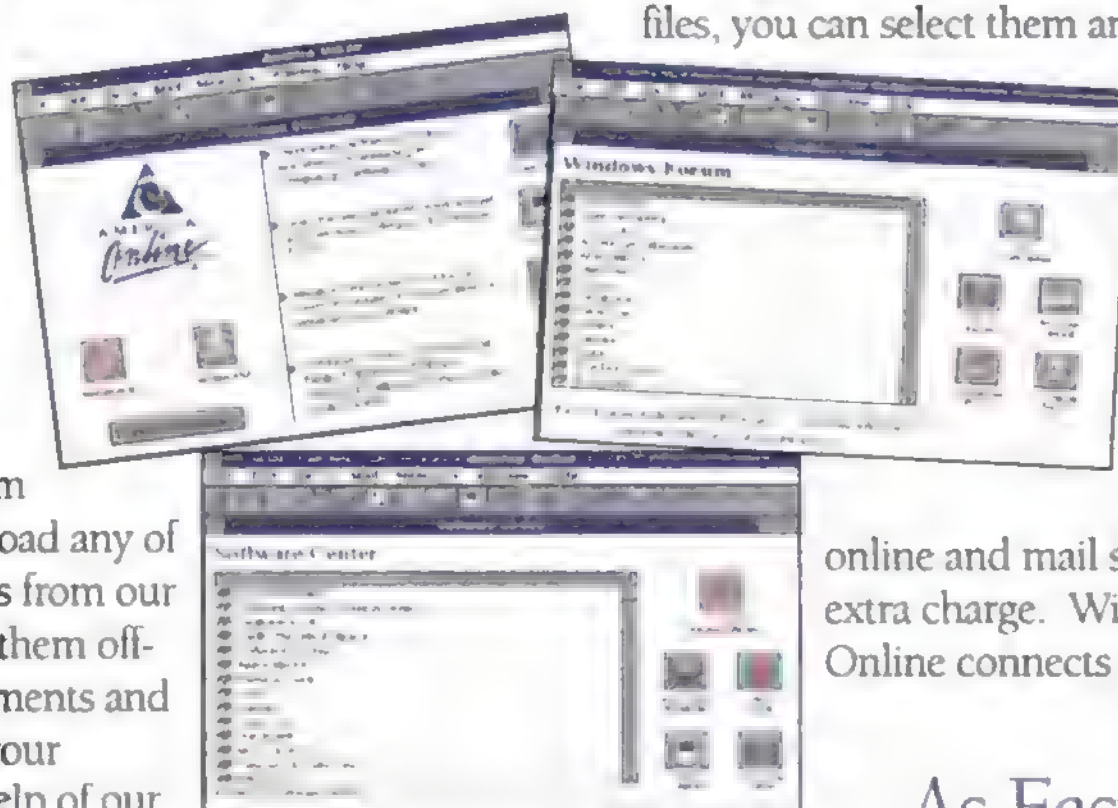
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SOFTWARE
On-Line Services

► **S U M M A R Y O F F E A T U R E S**

ENDS

Products listed in alphabetical order

■ = YES □ = NO



	America Online	CompuServe Information Service	Delphi	GEnie	Prodigy Interactive Personal Service
Financial Services (continued)					
Historical performance	■	■	□	■	■
Cost	None	\$0.50-\$25.00 per report	N/A	\$6.00/hour	None
Commodity prices	■	■	■	■	■
Cost per quote	None	2¢; 7¢ historical	5¢	None	None
Downloadable analysis templates	■	■	□	■	□
Cost	None	\$12.80/hour	N/A	None	N/A
Entertainment/hobby SIGs					
Special-interest groups (SIGs)	41	340	40	50	420
Public debate/Political forums	■	■	■	■	■
Minority forums	■	■	□	■	■
Children/teen forums	■	■	■	■	■
Health/family forums	■	■	■	■	■
Movie/entertainment forums	■	■	■	■	■
Consumer forums	■	■	□	□	■
Comparative pricing	■	■	□	□	□
Advertising on screens	□	□	□	□	■
Advertising in special forums	■	■	■	■	■
Educator forums	■	■	□	■	■
Homework help	□	□	□	■	■
Interactive lessons	■	□	□	■	■
College degree programs	■	□	□	■	■
On-line registration	■	N/A	N/A	■	□
Professional forums	More than 10	15	None	10	29
Small-business forum	■	■	■	■	■
Downloadable graphics and fonts	■	■	■	■	□
Downloadable games	■	■	■	■	Optional
Game clues and tips BBS	■	■	■	■	■
Interactive games	■	■	■	■	Optional
Interactive multiplayer games	■	■	■	Optional	Optional
Role-playing games	■	■	■	Optional	Optional
Modem-to-modem gaming	□	■	□	Optional	□
Travel					
Eeasy Sabre	■	■	■	■	■
OAG (Official Airline Guide)	□	Optional	Optional	■	□
Worldspan Travelshopper	□	■	□	□	□
User Support/Customer Service					
Manual	\$19.95	\$49.95 (with CIM)	\$19.95	\$14.95	Free
800 number for customer support	■	■	■	■	■
Hours	12:00-11:00 P.M. eastern, daily	8:00-12:00 A.M. eastern, M-F; 12:00-10:00 P.M. weekends	8:00 A.M.-11:00 P.M. eastern, M-F; 12:00-8:00 P.M. weekends	8:00-12:00 A.M. eastern, M-F; 12:00-8:00 P.M. weekends	12:00-8:00 P.M. local time, daily
Real-time on-line support	■	■	■	■	□
E-mail box for customer support	■	■	□	■	■
Customer newsletters	□	■	■	■	■

N/A—Not applicable. The product does not have this feature.



CompuServe's CIM interface puts matching flights in a scrolling window in Easysabre's airlines listings. Push buttons let you move up and down.

connect charges to access specialty databases such as ZiffNet's Computer Library and Support on Site.

FOR THE HOME

CompuServe is also helpful for personal use, as it has features such as the Zagat Restaurant Survey and many forums that focus on hobbies and political/social issues. But with so many premium fees and surcharges on various aspects of the service, individuals and families will want to consider CompuServe's pricing plans very carefully.

CompuServe is weakest in family offerings. There is only a single forum for children (Students' Forum) and the response time and quality of the answers we received to questions posted there were worse on this forum than anywhere else on the service. The service features no lively interactive games for children other than a simplistic Hangman.

While new users will have to consider all of the tradeoffs in the various pricing schemes to determine what is right for them, CompuServe is such a valuable on-line resource that it's difficult to imagine not being a member.

General Videotex Corp.

Delphi

BY ERIC BERLIN

Based on Delphi's own claims, this smallest of on-line services barely belongs in this review. Sure, Delphi costs less than

the other services here, but you get what you pay for. There's entertainment and good talk here but little else.

After an introductory offer (\$5 for 5 hours) has expired, there is a choice of two membership plans: the basic plan of \$10 a month for four hours and \$4 for every additional hour, or the 20/20 Advantage Plan, which for an initial \$19 fee allows 20 hours of access

for \$20 a month, with every additional hour costing only \$1.80. There is no extra charge for daytime use unless the user logs in via Sprintnet or Tymnet, both of which charge \$9 an hour (from 6:00 A.M. to 6:00 P.M. local time for Sprintnet and from 7:00 A.M. to 7:00 P.M. for Tymnet). Access at 9,600 bits per second is not fully supported.

These fees do not include Delphi's rather limited Premium Services, which range from stock quote listings, at \$0.07 per quote, to Dialog, which costs \$21 an hour. Dialog, a reference service, is impressive in scope but practically impossi-

ble for a beginner to negotiate. (Typing HELP within Dialog brings up a list of sites where training seminars are held.)

Last year, Delphi's owners, General Videotext Corp., bought BIX (Byte Information Exchange) from McGraw-Hill. BIX, a separate service from Delphi, is the haunt of *Byte* magazine readers and is aimed at programmers and developers. For \$13 per month and \$2 per hour in non-prime hours and \$9 per hour during

SUITABILITY TO TASK

	Delphi			
	POOR	FAIR	GOOD	EXCELLENT
E-mail	☒	☒	☐	☐
Downloads	☒	☒	☐	☐
Research	☒	☐	☐	☐
Finance	☒	☐	☐	☐
Home	☒	☒	☒	☐

the day, users can access BIX. BIX also offers a 20/20 plan giving you 20 hours of evening access for \$20 per month, with each additional hour costing \$1.80.

THRIFTY BUT LIMITED

The only other research aids that Delphi has are Grolier's Academic American Encyclopedia and Houghton Mifflin's Dictionary of Cultural Literacy, which do not carry additional fees, but better serve kids in need of homework help than they do adult professionals. Don't expect to start your financial empire here, either. The only assistance Delphi gives the arm-chair stockbroker is a financial news forum, along with the ability to look up stock and commodities quotes.

Delphi's focus is on entertainment, and to that end the service offers 40 Special Interest Groups (SIGs), including ones for computer users, for political discussions, and for showbiz aficionados, and there is a special SIG for teenagers (though anyone can access it). There are interactive games, a small-business forum, and a forum for desktop publishers.

Delphi has cultivated some unique regional information services in five metropolitan areas: Boston, Miami, Kansas City, and of all places, Buenos Aires, Argentina, and Montevideo, Uruguay. These include movie reviews, restaurant ratings, and entertainment listings. Our look at the Boston service found it well

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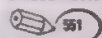
Delphi

General Videotex Corp., 1030 Massachusetts Ave., Cambridge, MA 02138; 800-695-4005, 617-491-3342; fax, 617-491-6642

List price: \$10 a month for up to four hours of connect time (\$4 for each additional hour of connect time), 20/20 Advantage Plan, \$19 start-up fee, \$20 for 20 hours of connect time per month (\$1.80 for each additional hour)

Requires: Modem, communications software

In Short: The smallest of the services in this review, Delphi is easy to use even though it has a stark, character-based interface. Its ease is largely due to the fact that there are not many features to access other than its entertainment options. And even though it's small, Delphi has a special regional flair that includes reviews of local restaurants and events



ON READER SERVICE CARD

SOFTWARE On-Line Services



Delphi features local restaurant reviews and entertainment options in regional forums, such as the one from Kansas City pictured here.

organized and up to date.

If you just want to chat with people across the country, or play some electronic poker, Delphi is all you really need. But anyone with professional or research needs will want to look elsewhere.

GENIE Service



BY ERIC BERLIN

General Electric's on-line service is one of the few with enough offerings to go up against CompuServe Information Service and come out on their feet in the areas of research and financial informa-

SUITABILITY TO TASK

GENIE				
E-mail	☒	☒	☒	☐
Downloads	☒	☒	☒	☒
Research	☒	☒	☒	☒
Finance	☒	☒	☒	☐
Home	☒	☒	☒	☐

tion. GENIE, however, still has far to go to match CompuServe on ease of use and sheer volume of information.

GENIE's front-end software, Aladdin, available as a download from the service, has been enhanced by a variety of user contributions over the years; hence it suffers from having had too many cooks. It is difficult to set up and configure, a prob-

lem for those who truly want to cut their on-line time to a minimum. For the rest of us, GENIE's own text interface is infinitely superior to Aladdin.

GENIE's \$4.95 per month Basic Service for weekends and evenings includes many—but not even close to all—RoundTables, GENIE's name for its bulletin boards. That's less than CompuServe's own \$7.95 standard rate,

"PROFESSIONAL" EXTRAS

None of these rates includes the Professional Services, which allow for almost any kind of research you might want to do. GENIE houses Dow Jones's impressive library of databases, for instance, which appears to have hundreds of sources for various topics. Prices for Professional Services run the gamut: \$3 for access to Advanced Research Technologies' Bookshelf to \$36 for a TRW credit report, for instance. For ongoing research, GENIE offers a clipping service for \$25 per month.

Financial services are also extensive. Users who have personal accounts with Charles Schwab & Co. can buy and sell stocks, follow the market in real-time (though this is probably not cost-effective), or

deal with the full array of commodities. Those without accounts can make do with other services, such as Dun & Bradstreet Corp.'s company profile database.

GENIE considers itself a leader in on-line games. Although dedicated gaming systems like The Sierra Network have an edge, GENIE has numerous gaming options, including a Family RoundTable

FACT FILE

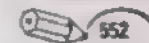
GENIE

GENIE Service, 401 N. Washington St.,
Rockville, MD 20850; 800-638-9636, 301-
251-6415; fax, 301-251-6421

List price: Basic Service (weekends and evenings) \$4.95 a month, Non-Basic Services (weekends and evenings), \$6 an hour; daytime access, \$12.50 an hour, daytime 9,600-bit-per-second access, \$30 an hour, 9,600 bps evening access, \$18 an hour

Requires: modem, communications software.

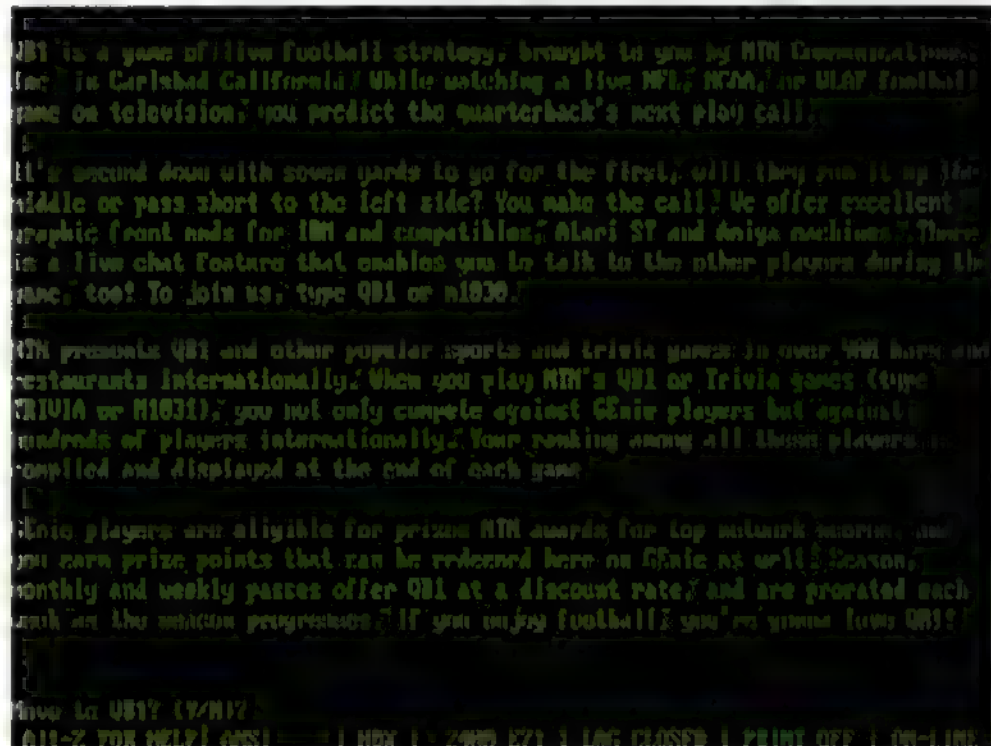
In short: After CompuServe, GENIE offers the most comprehensive research and financial information features among the services reviewed in this issue. GENIE also stands out for its interesting RoundTable special-interest forums and its many on-line games. But the service does not go quite as far as CompuServe does to make its old-fashioned text interface easier to use



ON READER SERVICE CARD

with private channels for children and teenagers.

Valuable forums include a RoundTable for home business use, GENIUS (a sort of town hall for any gripes and problems that are related to GENIE), and Showbiz RoundTable for determining



GENIE, despite its text interface, features graphical interactive games like QB1, which you play using front-end software that you can download from the service.

this weekend's hot movie. GENie also offers accredited college courses.

UNLIMITED E-MAIL

Internet mail, while not included in the Basic Services, is offered via a gateway and costs a very reasonable \$0.30 per 5,000 bytes, either sent or received. But there is no on-line help regarding the intricate web that is Internet.

If luck fails, you can always turn to toll-free help, which is available weekdays from 8:00 A.M. to midnight, and weekends from noon to midnight EST. That's a good thing if you don't care to spend \$14.95 for the manual, which is not included with membership. The manual is a good guide to the world of GENie's services, even if that world doesn't quite compare with CompuServe's universe.

Prodigy Services Co.

Prodigy Interactive Personal Service

BY GAYLE EHRENMAN

If CompuServe is *The Wall Street Journal* of on-line services, then Prodigy Interactive Personal Service is the *USA Today*: It's not the most technical source, but it gives you a vast quantity of easily digestible information presented in a graphically appealing way. Its offerings are broad-based, and its general feel is not intimidating.

The start-up kit (disks and a manual), retails for \$49.95, but it is readily availa-

ble at street prices of \$30 or less, and the Prodigy hardware bundles are too numerous to mention. The flat monthly charge of \$14.95 allows up to six separate users in each household. There are additional fees for many of the special services, including ZiffNet and the Baseball Manager game.

Each one of the screens features some type of CGA graphics. Ads appear on almost every screen; your eyes become rapidly accustomed to them, so they're not as big an intrusion as you might expect. These screens are slower to redraw but they add a richness to the content that the text-intensive screens of other on-line services cannot.

Navigating the service's hierarchical menus can be a chore, but as we went to press, Prodigy was working on making that easier with changes to its Jump menu. Jump lets you bypass whole series of menus by entering a keyword. You can also create a Personal Path (a series of jump words to your favorite haunts).

A SUPREME GENERALIST

For general information, the Prodigy service is hard to beat. There are a variety of expert columns available on the service, including *Investment Digest's* Brendan Boyd on finance, noted reporter Dick Schaap on sports, and Jack Germond, a regular on "The McLaughlin Group," on politics. For research, there is a fully up-to-date Academic American Encyclopedia (at review time in November, its Ross Perot entry detailed the billion-



Available only for major cities, Prodigy's City Guide menu screen provides the tourist with information on weather, restaurants, and places to go.

aire's on-again, off-again presidential campaign), news coverage from the Prodigy newsroom, and business reports from the Dow Jones News/Retrieval service.

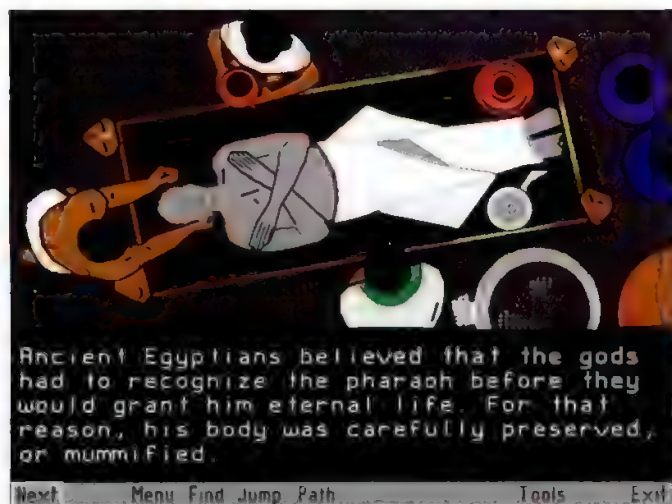
Hobbies, entertainment, and special interests aren't neglected, either. There are over 420 special interest groups represented on the service, ranging from veterans of Desert Storm to poets and writ-

SUITABILITY TO TASK

Prodigy Interactive Personal Service

	POOR	FAIR	GOOD	EXCELLENT
E-mail	●	○	○	○
Downloads	●	○	○	○
Research	●	●	●	○
Finance	●	●	●	●
Home	●	●	●	●

ers. Their bulletin boards are extremely active: Prodigy estimates that over 90,000 messages are posted daily. The service does, however, reserve the right to edit or delete any message deemed obscene or offensive. In addition to the bulletin boards, there are more action-oriented features such as on-line cookbooks for the culinary set, "This Old House" for the homesteaders, and job listings for the underemployed. Travelers are well served, too, with City Guides for helping you decide where to go, Eaasy Sabre and Book-A-Trip for making reservations, and the Zagat Restaurant Survey for deciding where to eat once you get there. There is also on-line shopping, with fewer



The Prodigy service's National Geographic lessons, such as "Inside a Pharaoh's Tomb," walk you through the daily activities of Ancient Egypt.



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FACT FILE

**Prodigy Interactive
Personal Service**

Prodigy Services Co., 445 Hamilton Ave.,
White Plains, NY 10601; 800-776-3449,
914-993-8000.

List Price: Start-up kit, \$49.95; flat usage fee, \$14.95 per household per month

Requires: 512K RAM, DOS 2.0 or later, CGA or better graphics adapter, 1,200-, 2,400- or 9,600-bits-per-second modem; mouse optional

In Short: The Prodigy on-line service is not for the power user, but it is a fine all-around choice for home users, and new software to upgrade its e-mail, which should be available by the time of this review, will strengthen one of this service's weak spots. Prodigy is also improving the accessibility of its menu system.



merchants represented than in the past, but with improved presentation, thanks to the addition of the Prodigy Mall.

Prodigy offers an impressive array of financial services. Along with business and economic news, Prodigy has Quote Check and Quote Track, which use the Dow Jones News/Retrieval service to provide 15-minute delayed quotes for stocks, bonds, and mutual funds, and for more than 50 market indices and key indicators. Strategic Investor, a \$14.95-per-month custom option, provides an extensive database of information on stocks and mutual funds, which can be downloaded for use in a spreadsheet program.

Children and teens have their own bulletin boards (which are carefully monitored, and in the case of the teen board, restricted to persons in the 14-to-20 age group), in addition to on-line story-telling, illustrated editions of *National Geographic*, *Weekly Reader*, and illustrated excerpts from the PBS show "Nova," as well as a host of simple and not-so-simple games, including a special edition of "Where in the World is Carmen Sandiego?"

AN E-MAIL ALSO-RAN

Prodigy falls short on computer technology services and e-mail. There are only three vendor-sponsored areas on the service with a limited number of vendors represented (17). There are two additional computer users groups and a bulletin board, but the level of technical expertise lags behind that which is available on other services. In addition, the service offers no download capabilities as part of its basic package. For downloads, you'll have to turn to the custom service, ZiffNet, available for \$14.95 per month for up to three hours of use, with additional hours billed at \$6.00 per hour. (Other ZiffNet pricing options include \$7.50 per month for one hour of use, plus 13 cents per additional minute, or an option that allows users to buy ZiffNet Selections in blocks of 100K. A user is charged \$3 for the first 200K or less, and \$1.50 for each additional block of 100K. ZiffNet Download Manager, a custom utility that helps new downloaders manage and use the selections, is available as a \$1 download. For a serious techie, this can mean big bucks.

E-mail can also be costly. Basic service only includes 30 e-mail messages per household per month; additional messages cost \$0.25 each. Further inhibiting e-mail junkies is the fact that you must

compose all messages on-line—which can tie up your phone line for hours—and you can't include attachments, send mail through the Internet, or save messages to a folder. There is a front-end program for Prodigy, called Pro Master (see the sidebar "Easing the Access") that alleviates some of the problems, but it does not go nearly far enough.

Some of these shortcomings should be eliminated by the time you read this review. Prodigy is adding the ability to compose messages off-line. It's also adding in-baskets and folders, and the ability to send and receive faxes, use attachments, send first class mail, and attach to the Internet. Other additions include 9,600-bit-per-second access and improved navigation and search capabilities.

In all, the good far outweighs the bad with the Prodigy service. For the most part, it succeeds in providing something for everyone, except perhaps the most technology-oriented users. As an information and entertainment service, it is a big winner.

Easing the Access

BY PRESTON GRALLA

Accessing the vast amounts of on-line information can be difficult and time-consuming, not to mention expensive. The larger the on-line service, the greater the difficulty.

Front-end software can help in two distinct ways. Some of it helps you to navigate through the information; some lets you save money by reading and responding to e-mail and forum messages off-line.

For this latter category, depending on how these programs are configured, you may download a descriptive title of messages, the messages themselves, or both. You read your messages off-line, respond to and create messages, and mark the headers of messages that you'd like to download. The program

then makes a second pass at the on-line service, uploads your messages, and downloads the messages whose headers you've marked, and so on. The programs can work in a similar fashion with file catalogs from forum libraries. You can

browse the catalogs off-line and mark the files you want to download. When you're back on-line they'll go automatically to the forum and download the files you want. This cuts on-line time and can also help to save you money. In addition, front-end software often makes it easier to follow messages and threads.

All, save one, of the products that we reviewed here—AutoSIG, TAPCIS, OZCIS, and CompuServe's own CompuServe Information Manager (CIM), and its Microsoft Windows version, Win-

*Some help you navigate
through information;
others read and respond
to e-mail and forum
messages off-line.*

SOFTWARE

On-Line Services

CIM—are designed for use with CompuServe. Golden CommPass, Version 2.0E, is an OS/2 front end to CompuServe. The Prodigy Interactive Personal Service, odd as it may seem in a service that's designed around its own front-end software, also has an alternative front end called Pro-Master.

On CompuServe, AutoSIG, TAPCIS, and OZCIS are used primarily to automate access to mail, forums, and forum libraries. CIM, both the Windows and DOS versions, make the CompuServe service easier to use, but they do not automate activity.

Instead of being a true front-end, Gateway Software's Pro-Master adds functions such as macros so that you can automatically move from area to area on the Prodigy service.

Another genre of front-end software that we did not review includes scripting packages that automate on-line activities for standard communications programs. For example, CISOP, a set of scripts for Crosstalk Mark 4, serves as a front end to CompuServe. And ZiffPlus, a set of scripts for the DOS version of ProComm Plus, makes it easier to access Ziff-Davis Publishing's own forum on CompuServe, ZiffNet.

Here is a look at how these front-ends rate, in terms of automation and navigation:

ON-LINE AUTOMATION

AutoSIG

AutoSIG is not a program for the faint of heart. It has gained a devoted band of followers as a pioneer in automating access to CompuServe. But some newer programs like TAPCIS and OZCIS are easier to use. AutoSIG (also called ATO) uses the same multipass operation that the others do, although if you want to use it for browsing forum libraries off-line you will need a separate module to generate scripts in order to do so.

ATO's interface makes TAPCIS look easy. Expect to spend a great deal of time figuring out how to navigate the program itself. On the plus side, there are a large number of add-ons that have been written to make ATO easier to use and to

perform sophisticated on-line tasks. There's even a Windows front end, called WinATO, that takes some of the pain out of using the program. But the best part is that it's free; you'll lose nothing except the cost of a download and the time you spend trying to learn it.

Golden CommPass

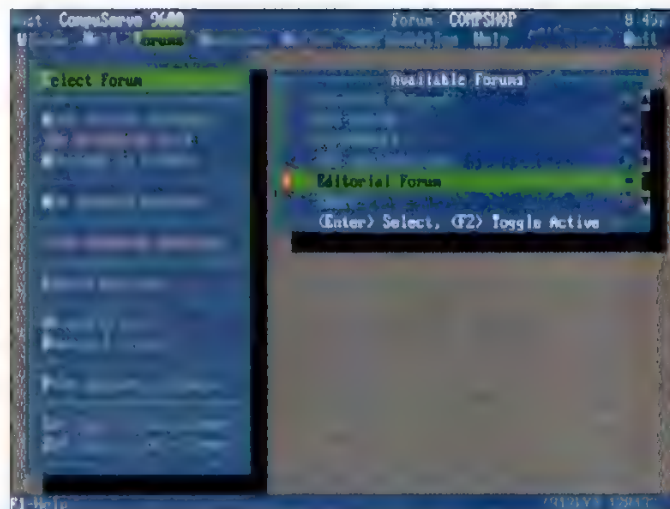
Golden CommPass is a multithreaded OS/2 application

that shares a number of the same features of TAPCIS, and in fact, is compatible with TAPCIS files and scripts. If you have been using TAPCIS, you need only copy your section files, parameter files, and scripts over to the Golden CommPass subdirectory, and you will be all set to use Golden CommPass without any further setup. Golden CommPass also

shares many of the TAPCIS commands, such as pressing the Escape button in order to remain on-line when the automated part of an on-line session would normally dump you out. For previous users of TAPCIS, the learning curve is minimal.

Unlike TAPCIS, Golden CommPass is a graphical application that takes advantage of OS/2's Workplace Shell (WPS). You can change the fonts in your communication screen, or in the editor (which, by the way, is one of the two editors that comes with OS/2). The communications screen is scrollable, so you can easily go back and look at information that whizzed by a bit too fast. You can also use the clipboard to copy and paste previous typed commands—another feature that TAPCIS, with its text-based interface, does not offer.

The downside of Golden CommPass is that because it's a new product (released only this past April), there are still



OZCIS has a menu interface with options that expedite access to CompuServe's message boards and that let you read and answer messages off-line.

a few bugs to work out. The program's author, Larry Finkelstein (User ID 76702,1354), is easily accessible through CompuServe and is very responsive about correcting the problems and buglets that users encounter. At this writing, a new version of the product that corrects many problems is going into beta testing. Golden CommPass currently is a 16-bit application, but a 32-bit version of the program is in the works and should be released by the end of the first quarter of 1993.

OZCIS

OZCIS, with its pleasing interface, automates access to CompuServe using the same multipass method that AutoSIG and TAPCIS use. You can use it for both messaging and downloading files.

OZCIS features pull-down menus and easy-to-access help within the program. The menus and mouse support make it easy to configure and use the program. OZCIS's help system is much more comprehensive and accessible than what you'll find in TAPCIS, and it is easier to configure and customize. It also has a fuller feature set and better message editor. Other pluses let you drop into terminal mode while on-line. After you finish your work in terminal mode, OZCIS will continue its automatic uploading and downloading of files and messages.

Additionally, OZCIS can automatically download text from certain parts of CompuServe, such as ZiffNet Highlights, that other navigational programs can't.

*AutoSIG, TAPCIS, and
OZCIS are primarily
used to automate access
to mail, forums, and
forum libraries.*

And you can configure it to run other programs, such as DOS or a word processor, from within the program. There are menu items for accessing nonforum parts of CompuServe as well.

Menus, however, can be difficult to follow at first, and seem to follow an eccentric logic of their own. This complaint aside, OZCIS will save you time and money, and it's easier to use than other multipass programs reviewed here. You also can't beat the price. For personal use, it's free.

TAPCIS

TAPCIS, despite its archaic-looking text-based user interface, remains a powerful tool for accessing CompuServe forums. It employs the multipass found in OZCIS and AutoSIG, allowing you to read or scan all messages in a forum, or download only messages sent directly to you. You can combine these preferences so that in a single forum, you can read all of the messages in some sections, scan the messages in some other sections, and completely ignore some sections altogether.

TAPCIS excels on downloads, allowing you to browse catalogs off-line and

way to let you read certain services off-line—ZiffNet Highlights, for example—unless you have a special script. And the interface is old; it needs work.

Still, TAPCIS is a powerful tool that has fathered a virtual subindustry of add-ins. It has one of the largest and most vocal user bases of any CompuServe access program, as well as its own forum on CompuServe so it's easy to find help.

ON-LINE NAVIGATION CIM and WinCIM

Instead of automating access to the forum and having you do most of your work off-line, CIM and WinCIM use menus and icons to make it easier to access every part of CompuServe. They give you a broader view of what's available, so you can more easily navigate the service. But if you're mainly interested in forums, it won't save any money: As a matter of fact, because of the front-end overhead, it could actually take you longer to retrieve and answer messages

ing of topics within that section, and the number of messages within each topic. Choose a topic, and the front-end software sends you into a message reader, where you can read and respond to messages on-line.

Other CIM tools let you browse forum libraries. And there are also some nice search tools. You can, for example, search for messages based on subject, sender, receiver, or section, or you can just search for specific files. The software also offers batch downloads of either messages or files. You

can browse through files, mark those you want to download, and then later download them all at once.

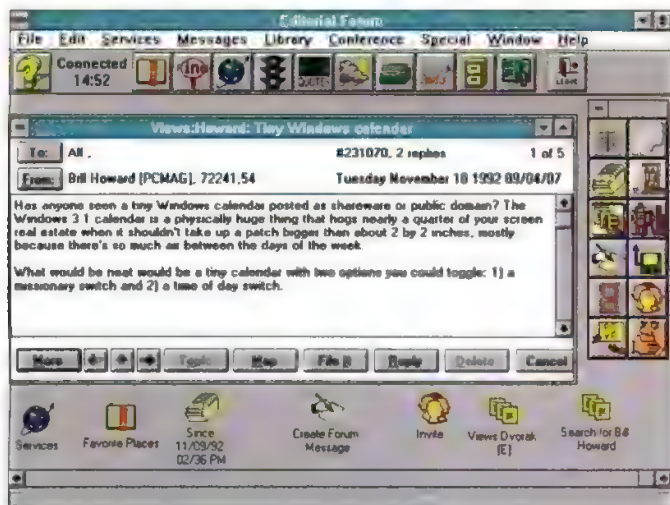
CIM's e-mail tools help you maintain an address book and allow you to save copies of incoming and outgoing messages to folders. You can also set up and delete custom folders. Moreover, you can compose messages off-line using a far better text editor than the rudimentary one that is offered on-line.

WinCIM builds upon this foundation. Its organization and makeup is very much like the DOS version. But the Windows environment provides nice extras—you can use Windows' Clipboard to cut and paste, for example. You can also use WinCIM's scrollbar buffer in combination with the Clipboard to paste text from WinCIM into other Windows applications.

Compared with CIM's text-based menus, WinCIM's graphical environment makes for a far more pleasing screen. Icons and ribbons also allow for easier navigation. Another plus is that WinCIM has taken tentative steps toward automating access to forums. It lets you mark messages you want to download and read off-line. It's not nearly as fully automated as are TAPCIS or OZCIS in this respect, but it's a first step.

To help those who want more tools for automation, CompuServe is currently at work on a Windows version of their Macintosh program, CompuServe Navigator, which will allow you to do much of your work off-line. It's scheduled to be released sometime in 1993.

***CIM and WinCIM let
you access all of
CompuServe from a
main screen using pull-
down menus.***



CompuServe's own WinCIM offers all the functionality of its CIM DOS-based product but with icons and buttons in a Windows interface.

mark only the files you want downloaded. CompuServe forum catalogs are generally updated on the first and the fifteenth of each month so you need only download catalogs periodically to stay current. TAPCIS will also keep track of your on-line costs if you tell it to do so.

The program does have some drawbacks. Unlike OZCIS, it doesn't have a

to any of those areas, select the menu item. CIM supports a mouse as well as a keyboard.

Unlike the automated programs, CIM presents you with a list of forum sections when you dial into a forum. It then tells you the total number of topics and messages within each section. Choose one of the sections, and CIM will show you a list-

On-Line Services

If you want to check into forums on a daily or weekly basis, then an automated program like OZCIS or TAPCIS will be a much better choice than either of the CIMs. But the CIMs' handling of e-mail is exemplary, and if you want to browse through new forums, these programs are a good bet. They are certainly easier to use than CompuServe's native commands. To order either version of CIM on-line, type GO CIS:CIM. Or you can type GO ZNT:ZCIM to order a version of CIM customized for accessing ZiffNet.

Pro-Master

The Prodigy service is certainly not terribly difficult to use. But its own graphical, menu-driven front-end software leaves out some of the features that users have come to expect from on-line services. While you still have the ability to save the text you've read on the screen in ASCII files, the way in which you do it is awkward. And, because you cannot upload a text file into a message, you are forced to use the Prodigy service's text editor, which means that you must compose your messages on-line. Cost is not the issue here since Prodigy charges a flat monthly fee. But users who have come to expect those capabilities in on-line communications will not have to do without if they use Pro-Master.

Pro-Master lets you easily save messages and Prodigy screens as text files, and it allows you to switch between printing messages on paper and saving them as text files. The software also lets you write macros that will automate your access to the service. If you always go to a specific bulletin board area of ZiffNet, for example, you can record a macro that will automatically send you there, instead of having to manually navigate through a lengthy series of menus.

The Pro-Master software package includes an editor that you can use to create messages to be uploaded to the Prodigy service, and it also includes a clipboard that can import text from the Windows clipboard (even though Pro-Master is a DOS application).

When you use Pro-Master, the Prodigy service still looks precisely as it did before. Pro-Master runs as a TSR (terminate and stay resident program), and you can access its features via a menu that

pops up over your Prodigy screen. You can also use a hotkey. The Pro-Master software doesn't change the essential nature of the Prodigy service. It is not a front end in the truest sense of the word, and it does not preclude the need for Prodigy's own front end. But it does give you a set of tools that make the service more useful and accessible. □

► **FACT FILE**

AutoSIG

List price: *Free.*Files: *ATOSIG.EXE and ATO-DOC.EXE (GO ZNT: TIPS, Library 11)*

Circle 532 on reader service card

► **FACT FILE**

CIM (CompuServe Information Manager) and WinCIM

CompuServe Inc., P.O. Box 20212, 5000 Arlington Centre Blvd., Columbus, OH 43220; 800-848-8199, 614-457-0802; fax, 614-457-0348.

List price: *\$10 plus download time (in return you get a \$10 usage credit); \$25 through the mail (in return you get a \$25 usage credit); documentation \$10.*

GO CIS: CIM or GO ZNT: ZCIM

Circle 533 on reader service card

► **FACT FILE**

Golden CommPass, Version 2.0E

Creative Systems Programming Corp., P.O. Box 961, Mount Laurel, NJ 08054-0961; 609-234-1500; fax, 609-234-1920.

List price: *\$99.*

Circle 534 on reader service card

► **FACT FILE**

OZCIS

Steve Sneed

Ozarks West Software, 14150 Gleneagle Drive, Colorado Springs, CO 80921.

List price: *Free for personal use.*

Circle 535 on reader service card

► **FACT FILE**

Pro-Master

Gateway Software Inc., 1230 Market Street, #402, San Francisco, CA 94102; 415-885-0593.

List price: *\$24.*Files: *PROM30.ZIP (GO CIS: IBMCOM, Library 2).*

Circle 536 on reader service card

► **FACT FILE**

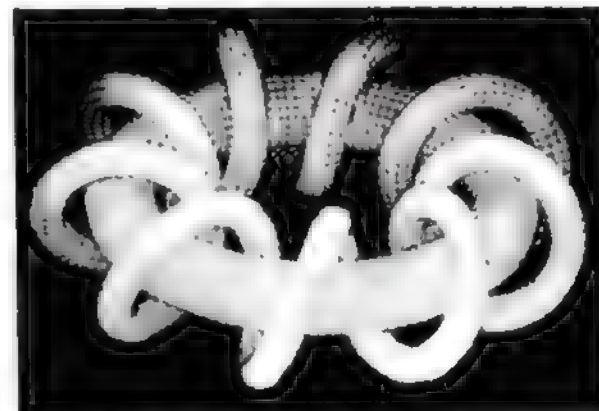
TAPCIS

Support Group, Inc., Lake Technology Park, McHenry, MD 31541; 301-387-4500.

List price: *\$79.*

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SETVER's Version Table

BY NEIL J. RUBENKING

MODIFYING SETVER'S VERSION TABLE

A glaring omission—at least for me—in the DOS 5.0's SETVER command is the lack of ability to delete all entries in the version table with one command. While I usually delete all of the entries when installing DOS 5.0, I still want to have SETVER.EXE loaded in case a need for it arises. That way I only have to instruct the user to enter the SETVER command, not modify CONFIG.SYS.

The Turbo Pascal program RMSETVER in Figure 1 fills this need. It is a filter, taking the output of the SETVER program and building a batch file with a SETVER filename /d line for each table entry. I purposely kept the program simple: No fancy invocation of COMMAND.COM to execute the created batch file, or direct modification of the SETVER.EXE file. After all, how many times will this program be run on any given machine?

To use the program, enter SETVER | RMSETVER at the DOS prompt. The result will be a file, RMSETVER.BAT, that is located in the default directory. Enter RMSETVER.BAT at the DOS prompt, and you're done.

*Pasquale Attanasio
Edison, New Jersey*

► **PC MAGAZINE:** The SETVER program in DOS 5.0 is a professional liar! Its occupation is lying to programs that use DOS services to check the DOS version. When SETVER is loaded, it intercepts requests for the DOS version and checks whether the calling program is on its list. If so, it reports the DOS version specified in the list, rather than 5.0. You can see the SETVER list simply by typing SETVER at the DOS prompt.

Chances are, though, your system doesn't include any of the programs managed by SETVER. Or, worse yet, one of your programs may have the same name as a program on SETVER's list. Of course, you could just remove the DEVICE=SETVER.EXE line from CONFIG.SYS, but instead the RMSETVER

program creates a batch file that simply removes all of the entries from the SETVER table. That way SETVER remains available if you actually need it, but doesn't cause any trouble if you don't.

The Turbo Pascal program that is shown in Figure 1 certainly does the job. If you don't happen to have a Turbo Pascal compiler, you can download RMSETVER.EXE from PC Magnet. Using this program, you can actually delete every one of the entries from the SETVER table with a single command line. Simply pipe the nonexistent output of RMSETVER.EXE into the RMSETVER.BAT file it creates:

```
SETVER | RMSETVER | RMSETVER.BAT
```

Still, I always prefer an all-batch solution when possible! SETVERD.BAT, shown in Figure 2, is quite a bit slower than RMSETVER.EXE, but it uses only standard DOS and batch commands. It also creates RESETVER.BAT, a batch file that will restore the SETVER table entries SETVERD erases. Of course the SETVER program must be available on the PATH or in the current directory.

The first thing SETVERD.BAT does is look for itself in the current directory. This is necessary because SETVERD.BAT extracts lines from its own code to create a temporary batch file. To do so, it needs to find itself. The easiest way to ensure that is to require that it run from the current directory.

Next SETVERD checks to make sure the SETVER table isn't already empty. It pipes the output of SETVER through the FIND filter looking for the string "No entries". Any line containing that string

will be redirected into the temporary file SV1\$\$\$\$\$.BAT; if the string is not present, this file will contain zero bytes. The next line copies this temporary file to another—SV2\$\$\$\$\$.BAT. The DOS COPY command won't copy a zero-byte file, so if the second file does not exist, some entries must be present in the table.

At the label YesEntries, SETVERD checks whether the SETVER device is loaded. You can run SETVER.EXE to view, add, or remove items from the SETVER table, but unless your CONFIG.SYS file contains a DEVICE= line that loads SETVER.EXE, the settings will have no effect. As before, the batch file pipes the output of SETVER through the FIND filter, this time looking for the string "device" in lowercase. If the SETVER device is loaded, SETVERD.BAT jumps directly to the label SVLoaded. If not, it passes an informational message to the user before jumping to the label SVLoaded.

Processing the list of SETVER entries is going to require two ancillary files, a small batch file and a tiny data file. Rather than require SETVERD.BAT to carry around two extra files, I included lines to create those ancillary files, starting at the label SVLoaded. Actually, the temporary file SV1\$\$\$\$\$.BAT's lines are embedded in SETVERD.BAT, just before the label SVLoaded. SETVERD.BAT extracts those lines by passing its own code through the FIND filter, seeking lines that contain two Tab characters. There are four such lines in SETVERD.BAT: the three lines that make up the temporary batch file and the line that contains the FIND command. A second pass through the FIND filter uses the /V switch to exclude the unwanted fourth line, and the result is redirected into SV1\$\$\$\$\$.BAT. It's not uncommon for one batch file to create another, but the usual method is to use ECHO and redirect each line into the secondary batch file. In this case, I couldn't use that technique because one of the secondary batch file's lines contains redirection symbols.

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SETVERD.BAT also requires a very special data file that contains the string "sv1\$\$\$\$", a character space, and nothing more—no carriage return, no line feed, no end-of-file character. It's hard to create such a file with batch commands, so I resorted to DEBUG. SETVERD builds a short DEBUG script, executes it to produce the data file SV1\$\$\$\$.CMD, and then deletes the script.

The next lines in the file initialize RESETVER.BAT, which will contain commands that reverse the action of SETVERD.BAT. RESETVER.BAT contains a standard @ECHO OFF line, a line that reports the batch file's function, and the command CTTY NUL. This command effectively makes your computer deaf and dumb—all output is suppressed and no input is accepted. The purpose of including CTTY NUL in the batch file that restores the SETVER table is to suppress the huge warning message generated by SETVER every time you add an item to the table. Do note, though, that if a batch file includes CTTY

NUL, it absolutely must call CTTY CON before finishing.

Now we're ready to roll! Just before the label Loop, the batch file pipes the output of SETVER through the FIND filter twice, selecting lines that contain at least one period and excluding any lines containing the string "device". The resulting list gets redirected into the temporary file SV1\$\$\$\$.\$\$\$, which will contain a line for each entry in the SETVER table, for example WIN200.BIN 3.40.

Each time through the loop, SETVERD.BAT passes the first line from the list of SETVER entries to the temporary file SV1\$\$\$\$.BAT, and then deletes the first line. It starts by using COPY to concatenate SV1\$\$\$\$.CMD with the list, storing the result in the temporary batch file SV2\$\$\$\$.BAT. The first line of this batch file will be something such as sv1\$\$\$\$ WIN200.BIN 3.40. When SETVERD.BAT uses CALL to execute SV2\$\$\$\$.BAT, this batch file in turn executes SV1\$\$\$\$.BAT, passing the line from the list file as a parameter. Since

SV2\$\$\$\$.BAT does not use CALL or COMMAND /C, control is transferred to SV1\$\$\$\$.BAT, and the remaining lines of SV2\$\$\$\$.BAT don't get executed.

SV1\$\$\$\$.BAT reports that it's removing this particular entry from SETVER and calls SETVER with the /D switch to perform the action. It also adds a line to RESETVER.BAT that will restore the entry.

After calling SV2\$\$\$\$.BAT, SETVERD.BAT has to strip off the first line. It does so by TYPEing the file and piping the output into the FIND filter, using the /V switch to exclude lines containing the string "sv1\$\$\$\$". The output of this command gets redirected back into the list file, SV1\$\$\$\$.\$\$\$. The result? The first line has been processed and removed from the list file.

At this point, when the last line in the list has been processed, SV1\$\$\$\$.\$\$\$ will be a zero-byte file. SETVERD.BAT tests for this condition by copying the file to SV2\$\$\$\$.BAT. As before, if the second file exists, the first is not yet zero

RMSETVER.PAS

Complete Listing

```

Program RmSetver;
{
  RMSETVER.EXE - Creates a batch file to delete all of the entries
                  in the SETVER.EXE table.
  Usage: SETVER | RMSETVER
  By: Pat Attanasio, CompuServe Id: 72481,371
}
CONST
  BatName : String[12] = 'RMSETVER.BAT';
  BatOpen : Boolean = False;
VAR
  RMSVBat : Text;
  SVText : String;
BEGIN
  WHILE NOT EOF(Input) DO
  BEGIN
    ReadLn(Input, SVText);
    IF NOT ((SVText = '')
      OR (SVText[1] = ' '))
    THEN
      OR (Copy(SVText, 1, 5) = 'NOTE:')
      OR (Copy(SVText, 1, 5) = 'No en')) THEN
        BEGIN
          IF NOT BatOpen THEN
            BEGIN
              Assign(RMSVBat, BatName);
              Rewrite(RMSVBat);
              BatOpen := True;
            END;
          Writeln(RMSVBat, 'SETVER ' + Copy(SVText, 1, 12) + ' /d');
        END;
      END;
    IF BatOpen THEN
      BEGIN
        Close(RMSVBat);
        Writeln(BatName + ' has been created');
      END;
    ELSE Writeln('No entries found in version table');
  END;

```



Figure 1: This Turbo Pascal program processes the output of the SETVER command and produces a batch file to remove all SETVER entries.

SETVERD.BAT

1 of 2

```

@ECHO OFF
ECHO SETVERD.BAT - Removes all entries from SETVER table

REM Make sure SETVERD.BAT is in current directory
IF EXIST SETVERD.BAT GOTO AnyEntries
ECHO Please run SETVERD.BAT from the current directory
GOTO End

:AnyEntries
REM First be sure there ARE any entries
SETVER | FIND "No entries" > SV1$$$$.$$$
COPY SV1$$$$.$$$ SV2$$$$.$$$ > NUL
IF NOT EXIST SV2$$$$.$$$ GOTO YesEntries
TYPE SV2$$$$.$$$
GOTO End

:YesEntries
REM If SETVER device not loaded, print a reminder

SETVER | FIND "device" > SV1$$$$.$$$
COPY SV1$$$$.$$$ SV2$$$$.$$$ > NUL
IF NOT EXIST SV2$$$$.$$$ GOTO SVLoaded
TYPE SV2$$$$.$$$
DEL SV2$$$$.$$$
ECHO (However, that won't stop SETVERD.BAT from working.) ECHO.
GOTO SVLoaded

REM These next three lines become SV1$$$$.BAT. REM
REM begins with two Tab characters.
ECHO Removing %1
ECHO SETVER %1 %2 >> RESETVER.BAT
SETVER %1 /D /Q

:SVLoaded
REM Creating ancillary files...
REM Create SV1$$$$.BAT - note that there are two Tab
REM characters between the first pair of quotes

```



Figure 2: This batch file removes all entries from the SETVER table and also generates the file RESETVER.BAT to restore them.

SETVERD.BAT

2 of 2

```
TYPE SETVERD.BAT | FIND " " | FIND /V "FIND" > SV1$$$$.BAT
REM Create SV1$$$$.CMD
ECHO N SV1$$$$.CMD > SV1$$$$.SCR
ECHO E 100 "sv1$$$$ " >> SV1$$$$.SCR
ECHO RCX >> SV1$$$$.SCR
ECHO 9 >> SV1$$$$.SCR
ECHO W >> SV1$$$$.SCR
ECHO Q >> SV1$$$$.SCR
DEBUG < SV1$$$$.SCR > NUL
DEL SV1$$$$.SCR

ECHO @ECHO OFF > RESETVER.BAT
ECHO ECHO RESETVER.BAT: Restoring SETVER table >> RESETVER.BAT
ECHO CTTY NUL >> RESETVER.BAT

ECHO Now removing all entries from SETVER table
ECHO.
SETVER | FIND " " | FIND /V "device" > SV1$$$$.$$$

:Loop
COPY SV1$$$$.CMD + SV1$$$$.$$$ SV2$$$$.BAT > NUL
CALL SV2$$$$.BAT
TYPE SV2$$$$.BAT | FIND /V "sv1$$$$" > SV1$$$$.$$$
COPY SV1$$$$.$$$ SV2$$$$.BAT > NUL
IF EXIST SV2$$$$.BAT GOTO Loop

ECHO CTTY CON >> RESETVER.BAT
ECHO ECHO Restoration complete >> RESETVER.BAT
ECHO.
ECHO All entries removed from SETVER table. Reboot to activate changes.
ECHO.
ECHO Run RESETVER.BAT to "restore" the removed entries.

:End
IF EXIST SV1$$$$.$$$ DEL SV1$$$$.$$$
IF EXIST SV2$$$$.$$$ DEL SV2$$$$.$$$
IF EXIST SV1$$$$.BAT DEL SV1$$$$.BAT
IF EXIST SV1$$$$.CMD DEL SV1$$$$.CMD
```

bytes long, so SETVERD.BAT loops, processing another line.

After all lines have been processed, SETVERD.BAT finishes RESETVER.BAT. It adds the necessary CTTY CON line, and another line that reports success. It then reports its *own* success and cleans up, deleting any leftover temporary files.

SETVERD.BAT is a complex batch file that illustrates a number of tech-

niques you'll surely find useful in your own batch files. For example, you can adapt the list-processing code at the label Loop to process just about any file, line by line. You may also find it convenient to store ancillary batch files *within* the main batch file as SETVERD.BAT does with SV1\$\$\$\$.BAT, and to generate special data files using DEBUG scripts. Best of all, it accomplishes the task of removing all entries from the SETVER

version table using nothing but standard DOS and batch commands!

You can download all of the files mentioned in this column (archived as SETVER.ZIP) from the PC MagNet Utilities/Tips Forum. □

Share your latest DOS and system discoveries through User-to-User. See the "How to Contact Us" sidebar in the Solutions column.

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Answers to Five Common Questions About Hard Disks

BY JEFF PROSISE

Over the years, *PC Magazine* has received thousands of queries from readers concerning hard disks. Certain questions come up time and time again. Hardly a month goes by, for example, in which Tutor does not receive questions asking about the different types of hard disks and hard disk controllers, about installing IDE drives in PCs with ST506 controllers, and about the dangers of low-level-formatting IDE drives. Here, then, are some straight answers to your questions about hard disks. If you have others, send them in and perhaps we can address them in a future column.

Q: What are the differences between the four most popular hard disk interfaces: ST506, ESDI, IDE, and SCSI? When shopping for a hard disk, what factors would lead me to choose one hard disk type over another?

A: At the hardware level, the chief differences lie in the drive electronics and in the division of labor between the drive and controller. For example, when an ST506 hard disk executes a read operation, it reads bits of data from the disk surface and sends them to the controller. On the controller, a data separator unit extracts the valid data bits from the other bits read from the disk (for example, bits from the sector headers that mark the beginning of each sector), and a deserializer unit assembles the raw data bits in preparation for placing them on the PC's bus. On ESDI, IDE, and SCSI drives, the data separators are housed on the drives, not on the controllers. This permits a tighter integration of the drive and the drive electronics, and is partially responsible for the higher throughput rates achieved by ESDI and IDE drives. An IDE drive is essentially a drive and controller rolled into one package, as its full name, integrated drive electronics, indicates. (For a

running glossary of hard disk terms, see the April 28, 1992, Tutor column.)

To most users, these kinds of details are unimportant. What matters most is speed, cost, and reliability. ST506 drives were used in the IBM XT and AT. They are the simplest and least expensive of the drive and controller types, but they are also the slowest and are generally available only in very low capacities (30MB or less). In addition, they are rapidly becoming a relic of the past, having been eclipsed by fast, inexpensive IDE drives. ESDI drives, which are faster than ST506 drives and available in much

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answers to these and other
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higher capacities (hundreds of megabytes), enjoyed a heyday in the late eighties but now appear to be on the decline.

The majority of hard disks sold today are of the IDE or SCSI variety. IDE drives are fast, with access times in the sub-20-millisecond range and throughput rates on the order of 10 megabits per second (compared with 5Mb per second for a typical ST506 drive). They are also extremely reliable, relatively inexpensive, and available in capacities of up to several hundred megabytes. Many PCs today have support for IDE drives built right into their system boards. Barring certain difficulties that arise when you at-

tempt to install two IDE drives from different manufacturers (some of the large IDE drive makers purposely build their drives so that they're incompatible with other brands), installing a new IDE drive in one of these systems is a snap. Just plug in a cable and flip a couple of switches on the back of the drive, and you're ready to go.

SCSI drives are also very fast, although they tend to cost more per megabyte than IDE drives. The primary attraction of SCSI is that it is theoretically possible to run up to seven SCSI devices (hard disks, tape drives, and CD-ROM drives, for example) off a single SCSI host adapter. However, SCSI remains a relatively immature standard in the IBM world, and setting up and configuring even one SCSI device to operate properly can be a nightmare. Getting two or more SCSI devices to work together is often impossible, because SCSI hardware manufacturers have yet to agree on a standard software protocol—so be careful. Unless you can't find comparable features in an IDE drive or your system simply will not support an IDE drive, you're better off buying IDE. (For a discussion of the IDE interface, see Lab Notes in the May 14, 1991, issue.)

Q: Can IDE and ST506 hard disks coexist in the same system? If I use an older PC that has an ST506 hard disk and controller, can I install a larger, faster IDE drive in the same PC?

A: Yes, you can—provided you install an IDE controller to attach the IDE drive to and that the controller you install was designed to coexist with other controllers. Generally, this means that the controller must contain its own BIOS and that it must enable you to configure it as a secondary hard disk controller. This configuration change is usually accomplished with a DIP switch or jumper setting. IDE controllers that fit these criteria

are available from at least two companies: UltraStor Corp. (714-581-4100) and Procom Technology (714-549-0527).

Configuring a hard disk controller as a secondary controller changes the range of I/O addresses it uses. By convention, ports 1F0h through 1F7h are reserved for the primary hard disk controller; secondary controllers use 170h through 177h. If you can't change the I/O addresses on the secondary controller, the two controllers will conflict with each other. A secondary IDE drive controller needs its own BIOS because the vast majority of system board BIOSes will only communicate with the primary hard disk controller. The BIOS on the IDE controller taps into interrupt 13h (the BIOS disk services interrupt) and intercepts calls intended for hard disks attached to the secondary controller. Also, some system board BIOSes built to interface with ST506-type controllers will not work with IDE controllers, even though the IDE software interface closely parallels that of the ST506.

Another potential pitfall to watch out for when you retrofit an old PC with a newer IDE drive is that the hard disk parameter tables burned into the PC's ROM may not support large hard disks. Some IDE drives and controllers will recognize this deficiency and employ workarounds to circumvent the problem. Low-level hard disk managers such as Disk Manager from Storage Dimensions will also let you use hard disks whose characteristics do not match those stored in your PC's ROM. Be smart: Research very carefully before you buy, and be sure to ask the drive manufacturer if the IDE drive you're thinking of purchasing will work in the system in which you plan to install it.

Q: Is it true that IDE drives cannot be low-level-formatted? If so, why? And should this prevent me from buying an IDE hard disk?

A: Most IDE drives can only be low-level-formatted by the manufacturer. For maximum positioning accuracy, most IDE drives use a closed-loop servo-voice coil mechanism to move the drive heads. That is, when the drive is instructed to move its head to a particular track, it moves to the track's approximate location and then uses servo information stored on the disk surface to lock in on the exact location. This servo informa-

tion consists of precisely located timing pulses.

In early servo voice-coil designs, the servo information was stored on a dedicated drive platter, but in modern IDE designs, it's embedded in the tracks along with sectors and sector headers. The servos are created when the drive is low-level-formatted. Standard IDE controllers lack the sophisticated electronics required to place these servos on the surface of the disk at the precise locations where they must appear, so the drives must be low-level-formatted before they leave the factory. Some IDE drives can be rendered unusable if you attempt to perform a low-level format on them, so I recommend that you don't even try it. Most IDE drives will resist your efforts to reformat them, but if yours doesn't, you'll ruin it.

Should this affect your decision to buy an IDE hard disk? Not really. There are four reasons why you might want to low-level-format a hard disk, and none of them apply to IDE hard disks. Reason number one is that you purchased a new hard disk and it didn't come low-level-formatted from the manufacturer; this will not be the case when you buy an IDE drive. Reason two is that you want to change the interleave. IDE drives are typically formatted with 1:1 interleaves and are tuned to deliver optimum performance at 1:1, so there's nothing to be gained from changing to a higher interleave. Number three is that mechanical wear and tear has caused misalignment between the drive heads and the tracks

on the disk that were created when the drive was low-level-formatted, resulting in "Sector not found" messages when you attempt to read or write to a file. This problem, while prevalent among older hard disks that used stepper motor drives to actuate the drive heads, is rarely a concern with voice coil drives. The servos on the disk effectively defeat align-

ment drift by allowing the drive heads to seek to the same point on the disk every time, independent of temperature and mechanical constraints. And finally, reason number four is that you want to scan the disk for surface defects and flag bad sectors. Sophisticated disk maintenance programs such as SpinRite II from Gibson Research can mark bad sectors without low-level-formatting the drive.

In short, don't be put off by the myth that you shouldn't purchase an IDE drive because you can't low-level-format it. IDE drives are fast, reliable, and affordable, and they come in a wide range of capacities. These characteristics, together with the fact that many system manufacturers now build support for IDE drives into their motherboards, make IDE drives the ideal choice for the majority of users.

Q: If I use a disk-caching program, how much RAM should I set aside for the cache?

A: With the latest generation of disk-caching utilities, which employ advanced cache-management algorithms that do not penalize you for large cache sizes, the answer is: The more the better.

The more RAM you set aside to cache data going to and from your hard disk, the faster the hard disk will appear to operate. However, very few of us have unlimited amounts of RAM at our disposal, so there is an inevitable trade-off between speed and the amount of RAM left over for application programs to use. The ideal cache size, then, is the one that provides a reasonably high degree of per-

Hit Rate vs. Cache Size

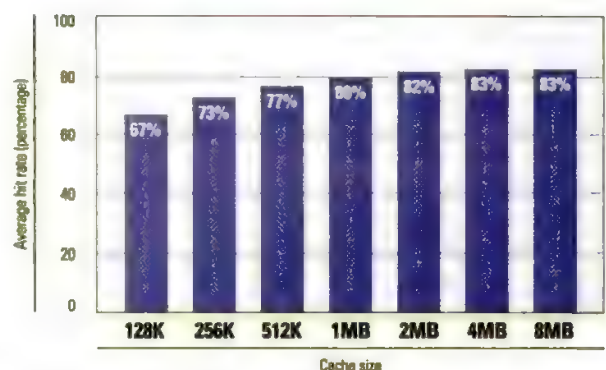


Figure 1: This diagram of average hit rate versus cache size illustrates how performance levels off as the cache size increases. We sampled the hit rate while running a mix of DOS and Windows applications under Microsoft Windows 3.1. The disk-caching program was SmartDrive, Version 4.0.

formance while consuming as little RAM as possible.

Figure 1 shows a graph of hit rates versus cache size for SmartDrive 4.0 (the version that comes with Windows 3.1). The *hit rate* is the percentage of the time that data requested from the hard disk is obtained from the cache rather than by a physical disk access. I obtained the data points while running a mix of DOS and Windows application programs in Windows 3.1. Notice that cache sizes larger than 1MB deliver only marginal gains in the hit rate. Therefore, a cache size of 1 to 2MB is ideal in this situation, provided you can afford to give up that much RAM. If your system has 4MB or more of RAM installed, a 1MB cache size is not at all unreasonable. For a 2MB system, however, a cache size of 256K or 512K would strike a more reasonable compromise between disk performance and memory consumption.

Q: If I have a caching hard disk controller, should I also use a software-based disk cache such as SmartDrive?

A: It depends. In some cases, a software cache will enhance the performance of a caching controller. In other cases, it may impede performance, especially if the software cache isn't significantly larger than the hardware cache.

How can you tell whether a software cache will help or hurt your system? Easy. Use a performance-testing program to gauge the performance of your hard disk with and without a software cache installed. You can use PC Magazine Labs' benchmark tests: Select the disk throughput test with a 1 or 2MB file size. These file sizes strike a reasonable compromise between the small reads that DOS applications normally perform and the large reads that Windows sometimes performs. If you use a relational database program such as dBASE and typically access large database files, perform the disk throughput test with a file size that more closely matches the size of the database files.

To obtain a free copy of the benchmark test programs that *PC Magazine* uses in its product testing, write to PC Labs, One Park Ave., New York, NY 10016-5802. Be sure to include your name, address, and phone number, and specify that you want a PC Magazine Labs Benchmark Series disk. Or you may fax your request to 212-503-5518. □

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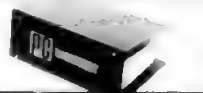
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Demystifying CONFIG.SYS in OS/2 2.0, Part 1

BY JOE SALEMI

So much for the rumor that OS/2 wouldn't even need a CONFIG.SYS file. In sheer size, the CONFIG.SYS file in OS/2 2.0 dwarfs the one in DOS, and the many cryptic new commands are more conspicuous for their number than for their documentation.

You can get a good deal of information about most of the CONFIG.SYS commands and their optional command lines from the on-line OS/2 help and documentation system. To access this system, you click on the Information icon on the main desktop; this will open a folder that has icons for the Command Reference and Master Help Index. You can then use pull-down menu options to search these references and create print-outs of the different topics. What a nuisance!

Some additional information is available in the installation manuals provided with the software, and there are a number of books, such as *Using OS/2 2.0* (Que), by Barry Nance and Greg Chicares; and *Inside OS/2 2.0* (New Riders Publishing), by Camarda, Little, Minasi, and Semple. Both were reviewed in the January 12, 1993 issue of *PC Magazine*. But it's hard to find a good single source from which to learn how to use all the new CONFIG.SYS commands to set up the operating system and tune its performance.

Not everything is new, of course. In the explanations that follow you'll notice that the OS/2 CONFIG.SYS includes some familiar statements and commands that are found in traditional DOS CONFIG.SYS or AUTOEXEC.BAT files. The reason is simple: Since CONFIG.SYS is the first file loaded, it's the ideal place to set system-wide configuration parameters and options. Like its DOS counterpart, OS/2's CONFIG.SYS is read and loaded only when the system

boots. If you make any changes to the file, you must reboot your machine for the changes to take effect.

OS/2 also supports a STARTUP.CMD file, which executes after CONFIG.SYS is loaded during the system boot. (.CMD files are the OS/2 equivalent of DOS .BAT files and support a superset of the DOS batch commands.) The function of STARTUP.CMD is similar to that of the DOS AUTOEXEC.BAT, in that it can load network drivers and start OS/2 applications automatically.

Each DOS or Windows session under OS/2 can also have its own individual ver-

part, the order of the statements and commands in the CONFIG.SYS file is of little consequence. The only time order is important is when you load options for a specialized device, such as a CD-ROM or HPFS (High Performance File System) drive. In such a case, you must make sure that the statements that load the device in question are positioned before any other statements that depend on access to it.

I've broken down the various OS/2 2.0 CONFIG.SYS statements into a number of broad categories in order to make it easier to describe what they do. My categories are largely arbitrary, and many commands or statements could easily fit into more than one. Nevertheless, grouping the CONFIG.SYS statements according to their primary function will make it easier for you to refer to these Lab Notes for configuration guidance when you add applications or hardware to your system.

The first category is Operating System Commands, which set up OS/2 itself for proper operation on your machine. Next come Optional Devices; these statements load particular device drivers for the hardware and software options you may have. Commands in the third category—Memory Management and Performance—are interrelated; they are used to balance system performance against the amount of memory used. Finally, there are the Application Configuration and User Preferences statements, which control how applications behave and let you customize the system to your satisfaction. I'll cover Operating System Commands, Optional Devices, and Memory Management in this part, and I'll discuss the remainder in the next installment of this column.

OPERATING SYSTEM COMMANDS This first group of commands and statements control the basic OS/2 2.0 services and

***OS/2's CONFIG.SYS
commands are more
conspicuous for their
number than their
documentation. This handy
guide fills in the gaps and
helps you tune your system.***

sion of AUTOEXEC.BAT, which is used to load programs and set configuration options that apply only to that session. Further, OS/2 2.0 permits on-the-fly loading of device drivers that apply only to a particular DOS or Windows session. These are handled as part of the session's settings in the Settings Notebook. These DOS session configuration and tuning capabilities deserve their own discussion and will be covered in another Lab Notes in the near future.

OS/2 reads the entire CONFIG.SYS file and only then executes the various commands it contains. Thus, for the most

operations. You can usually leave their default settings as established when the operating system was installed. The most common exception is the line that controls the location of the swap file, which I'll discuss below in connection with the SWAPPATH command.

BASEDEV= This statement loads the basic device drivers OS/2 uses to provide system services. OS/2 can't rely on the system BIOS in non-IBM PCs, whose BIOS services may not have been designed for use in a multitasking operating system. IBM PS/2's include an additional BIOS (called the Advanced BIOS or ABIOS) that is designed for multitasking, and this is automatically sensed and used by OS/2.

Depending on your system, you'll have one or more BASEDEV statements in CONFIG.SYS. You should not have to change any of them, as OS/2 loads the proper drivers either during installation or when you add additional devices through the System Setup program. However, third-party hardware boards, such as SCSI CD-ROM controllers, may require you to add a BASEDEV line to load the proper drivers. The manual that comes with the board should explain what needs to be added or changed. Note that in no case should you put a space on either side of the equals sign in the statement.

DEVICE= This statement loads both necessary and optional OS/2 device drivers. The statement works just as it does in DOS, and under OS/2 2.0 you can still load DOS device drivers in CONFIG.SYS. Drivers loaded in this way will be available in every DOS and Windows session.

The device drivers that must be loaded for proper operation of the operating system are listed in Figure 1. I'll discuss optional device drivers in a little while.

FCBS= As in DOS, this command specifies the number of File Control Blocks that can be active for older DOS programs. FCBs are generally obsolete, since they're used primarily by programs designed for DOS 2.x. FCBS takes two parameters, max and protected, which must be separated by a comma. Max sets FCBS's value to a number from 0 to 255 (the number of FCBs available for all DOS sessions). The protected parameter

Essential Drivers in OS/2 2.0	
Device Driver	Descriptions
COM.SYS	Loads the serial port support for use with an external device such as a modem. If you have a PS/2, this driver is called COM02.SYS instead.
DOS.SYS	Provides support for virtual DOS sessions.
MOUSE.SYS	Loads the device driver for a particular pointer type, for example, a mouse or trackball. Added parameters here specify the type of mouse, such as TYPE=PDIMOUS for an IBM PS/2 mouse, or TYPE=PCMOUS for a PC Mouse Systems or a Logitech mouse. Serial mice default to COM1, but you can specify a different serial port by adding SERIAL=COMn, where n is the port number for your mouse.
PMDD.SYS	Provides support for drawing the mouse or other custom pointer in the Workplace Shell.
POINTDD.SYS	Provides mouse support in OS/2.
VCOM.SYS	Loads serial port support for DOS sessions.
VDPMI.SYS	Loads DPMS support for DOS sessions.
VEGA.SYS or VGA.SYS	Loads EGA or VGA extended graphics support for DOS sessions.
VEMM.SYS	Loads EMS memory support for DOS sessions.
VMOUSE.SYS	Loads mouse support for DOS sessions.
VWIN.SYS	Loads Windows 3.x support.
VXMS.SYS	Loads XMS memory support for DOS sessions. You must add the /UMB parameter at the end of the statement to enable upper memory block support in a DOS session.

Figure 1: Each of these entries, preceded by **DEVICE=**, should be found in every OS/2 CONFIG.SYS file; these drivers must be loaded for proper operation of the operating system.

tells OS/2 how many FCBs to keep open and not recycle when needed by another program; the OS/2 2.0 default of FCBS=16, 8 is sufficient for most users.

IOPL= This statement controls whether an OS/2 program can bypass OS/2's built-in protection against directly writing to disk. Under DOS, applications are allowed to use built-in BIOS services to read and write directly to specific sectors on the disk, regardless of whether these sectors are being used by another program. OS/2 normally prevents this from happening in order to protect the file system.

IOPL, which stands for Input/Output Privilege Level, has three possible states. A YES parameter allows any program that uses the proper OS/2 API calls to access the disk hardware directly, and a NO means that no program can access the disk directly. IOPL=NO provides the best protection against problems caused by inadvertently writing directly to an executable file.

Unfortunately, however, a number of older OS/2 programs, such as Lotus 1-2-3/G and WordPerfect for OS/2, require that IOPL be set to YES. With such

applications in mind, OS/2 2.0 lets you provide at least some protection against accidental disk overwrites. You do this by listing on the command line the names, separated by commas, of the executable files to which you want to grant IOPL privileges. Your IOPL line would thus look something like this:

```
IOPL=123.EXE,WP.EXE
```

This alternative provides the best compromise between total prohibition and complete permission. Programs that need IOPL privileges and don't get them will usually produce an error message that tells you to add them to the IOPL line.

LIBPATH= This statement tells OS/2 where to find the system and application DLLs (dynamic link libraries). The command follows the same format as the DOS PATH statement, using semicolons to separate the list of subdirectories to be searched for DLLs.

The first item in the LIBPATH list should be a single period, which tells OS/2 to look in the current directory first. If this period is omitted, OS/2 won't look

for a DLL there and will give you an error message if it can't find the appropriate DLL in any of the other, listed LIBPATH directories. Note that this command does not create an environment variable, so it can't be changed on the fly.

PAUSEONERROR= This command takes only two parameters, YES or NO. The default is YES, which tells OS/2 to stop if it finds an error or problem while processing the CONFIG.SYS file. It will then produce an error message and require you to press any key to continue. NO still produces an error message, but it will probably scroll off the screen before you have a chance to read it. Leave PAUSEONERROR set to YES.

PROTECTONLY= This statement controls whether OS/2 prohibits DOS and Windows sessions. The default NO lets you run DOS and Windows programs under OS/2. Probably the only time you'd set it to YES is if the system is being used as a dedicated LAN file server or database server, in which case OS/2 should have full access to the system's resources. If you do set PROTECTONLY to YES, you can free up some RAM by removing all the **DEVICE=** statements that load drivers used only in DOS and Windows sessions.

PROTSHELL= This statement tells OS/2 which primary user interface shell to use. The default is PMSHELL.EXE, which is the graphical WorkPlace Shell. As an alternative, you can tell OS/2 to use the OS/2 command line processor, CMD.EXE, as its main shell. If you do so, however, you can run only character-mode applications, and then only in full-screen mode. Further, choosing CMD.EXE restricts you to one session at a time, as it provides no way to switch between open sessions.

SHELL= Identical to the DOS SHELL command, this statement tells OS/2 which command processor to use in DOS and Windows sessions. The default is OS/2's version of COMMAND.COM, which takes the same command line parameters as the DOS COMMAND.COM. In its place you could substitute any other DOS command processor, such as the shareware utility 4DOS, or the NDOS that comes with the Norton Utilities from Symantec.

SWAPPATH= This command tells OS/2 where to put the swap file it uses to store

data temporarily when it needs to free up system RAM. SWAPPATH takes three parameters: the drive and subdirectory to be used; the maximum size of the swap file (expressed indirectly, as the number of kilobytes to be left free on the swap drive); and the starting size of the swap file, also in kilobytes. OS/2 will increase the size of the swap file as needed, up to the permitted maximum. OS/2 defaults to different starting sizes; the more physical memory present in your system, the smaller the swap file, as illustrated below.

```
4MB RAM    = 6MB swap file
8MB RAM    = 4MB swap file
12MB+ RAM  = 2MB swap file
```

The amount of disk space to be left available usually defaults to 512K. Thus, if your system has 4MB RAM, your SWAPPATH statement will look something like

```
SWAPPATH=C:\OS2\SYSTEM 512 6144
```

If you have 8MB, it'll look like this:

```
SWAPPATH=C:\OS2\SYSTEM 512 4096
```

There are two reasons for changing the SWAPPATH setting. If you have a system that's split between FAT and HPFS drives so that you can use the dual-boot facility to switch between DOS and OS/2, you should point the swap file to a directory on an HPFS drive to gain the extra performance HPFS gives. You should also change it if you have a drive that has more free space than the default C:. Make sure you check the size of the swap file after a normal day's usage; if it's much bigger than the default, you should increase its initial size to speed up swapping as the day progresses. Note that the value you set for SWAPPATH= is meaningless if you don't have disk swapping turned on in the MEMMAN= command. (See the section on Memory Management below).

SET varname= OS/2 uses the SET command in the same way DOS does; that is, to establish environment variables (*varname*) that can be used either to control the entire system or to affect the way individual applications behave.

Global SET commands are put in the CONFIG.SYS file and affect the operat-

ing system itself and every session started under it. Local SET commands, on the other hand, affect only a particular session and can be placed in a .CMD or .BAT file used to run a program in that session.

OS/2 uses a number of SET commands to configure itself. These are listed below and can usually be left at their installation defaults.

- **SET AUTOSTART=** There's very little documentation anywhere on what this line does. Through experimentation I've found that one of its functions is to control which programs and system services are automatically started when the WorkPlace Shell starts. It defaults to PROGRAMS,TASKLIST,FOLDERS when the system is installed. I strongly advise against changing this line until it's better documented, as setting it incorrectly can prevent the system from running properly—and maybe even from

Be sure to check the size of a swap file after a normal day's usage; if it's much bigger than the default, you should increase its initial size to speed up swapping as the day progresses.

booting and running at all!

- **SET COMSPEC=** This line determines which command processor is to be used in OS/2 character-mode sessions. It defaults to CMD.EXE, the OS/2 equivalent of the DOS COMMAND.COM. The only reason to change it is if you decide to use a command shell replacement such as 4OS2, the OS/2 version of the 4DOS shareware program.

- **SET OS2_SHELL=** This command tells the OS/2 user interface (specified in PROTSHELL) which operating system shell to load for OS/2 character-mode sessions. It also defaults to CMD.EXE and can be replaced by a third-party command shell such as 4OS2.

- **SET RUNWORKPLACE=** This command determines the primary GUI shell. It de-

faults to PMSHELL.EXE, which runs the familiar WorkPlace Shell (WPS) interface. There are currently no alternative GUI's for OS/2, so this should be left at the default. In the future, this variable could be used to run a program such as an OS/2 version of the Norton Desktop for Windows.

- **SET SYSTEM_INI=** This statement specifies the .INI configuration file to be used for the operating system settings. It defaults to OS2SYS.INI and doesn't usually have to be changed. This file controls the folders (and their contents) that should appear on the desktop. It also keeps track of any programs in the STARTUP folder that should be executed when the system boots.
- **SET USER_INI=** This establishes the .INI file that holds configuration options chosen by the user, such as user-selected colors and fonts for the WPS. The default is OS2.INI. Application developers can also use this file to store custom configuration settings for their OS/2 applications. Again, it usually doesn't have to be changed.

OPTIONAL DEVICES These statements let you load optional device drivers for DOS, Windows, or OS/2 peripherals or file systems. OS/2 is smart enough to distinguish between DOS/Windows and OS/2 drivers, and so uses the DOS drivers only when a DOS or Windows session is active.

DEVICE= As mentioned previously, this command also loads optional device drivers for use either under OS/2 or in DOS sessions. The most common optional device driver you may want to add to your system is OS/2's ANSI.SYS. Like its DOS equivalent, it provides DOS sessions with access to the ANSI commands that control cursor location, text color, and so on. You could also load any other ANSI driver you prefer.

Other optional drivers included with the operating system are VDISK.SYS and EXTDSKDD.SYS. The former creates a RAM disk up to 4MB in size, and the latter supplies extended disk support for internal or external floppy disk drives; for example, the 3.5-inch 2.88MB ultra-high-density types.

You could also use a **DEVICE=** statement to load drivers for any other devices you want to have active in all DOS sessions, perhaps for a sound board or for

a CD-ROM drive that doesn't yet have OS/2 drivers available. Note that, as an alternative, OS/2 lets you load a DOS device driver through the DOS Settings for a particular session. In this case the driver is active only in that session.

DEVICEHIGH= This command is used only for loading DOS device drivers. As with its MS/PC-DOS 5.0 complement, it loads DOS drivers into available UMBs (upper memory blocks). The next section, on Memory Management, supplies details about activating UMB support in DOS/Windows sessions in OS/2.

IFS= IFS stands for Installable File System. The most common IFS currently available is the High Performance File System (HPFS). Introduced in OS/2 1.2, HPFS is a significant improvement over the FAT file system used by DOS. The HPFS includes such advanced features as a built-in hot fix, which automatically detects and locks out bad disk sectors and moves any data from such sectors into a "safety zone"; more efficient file storage, achieved by using 512-byte sectors instead of 2K clusters as the minimum storage area; and faster disk access, thanks to a BTree-based file directory structure.

Before formatting a disk partition with the HPFS, you must load the HPFS driver as the very first driver in your CONFIG.SYS. It's important to note, moreover, that while DOS and Windows sessions under OS/2 can access files on an HPFS drive, regular DOS cannot. Therefore you should not put important programs or files on an HPFS drive if you need to access them through plain DOS on a dual-boot system.

The HPFS driver has a number of options that affect the system's operation and performance.

- **/CACHE:x** or **/C:x** This parameter determines the size of an HPFS disk cache only; it has no effect on FAT drives. The *x* is the cache size in kilobytes. It usually defaults to a small number, which should be adjusted to a higher value for better performance. The proper value depends on two factors: the amount of system RAM, and whether you're running an all-HPFS system or a split system with both HPFS and FAT drives. If you're running an all-HPFS system, you should increase the setting to one of the following values, based on the amount of your system RAM:

4-5MB RAM	128K cache
6-7MB RAM	256K cache
8-9MB RAM	384K cache
10-16MB RAM	1MB cache
16MB+ RAM	2MB cache

If you're running a mixed system, you must divide the cache memory between the HPFS cache and the FAT cache. (The separate amounts are controlled by the DISKCACHE statement, which will be covered next time in the Performance section.) The split should reflect which file system has the most disk space. If you have a 200MB hard disk with a 50MB HPFS partition and the rest of the disk configured for a FAT, for example, you'd give the FAT cache the larger of the two numbers in the following list:

4-5MB RAM	128 & 64K caches
6MB RAM	256 & 64K caches
7MB RAM	256 & 128K caches
8-9MB RAM	266K for both caches
10-16MB RAM	512K for both caches
16MB+ RAM	1MB for both caches

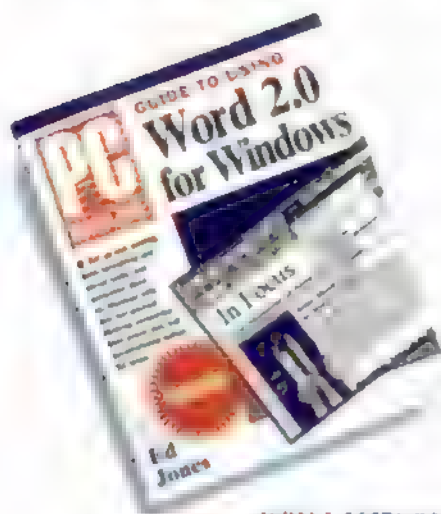
(Note: These numbers are taken from "OS/2 2.0 Installation and Performance Considerations" by Ron Morrill and Ron Cadima, which appeared in the October 1992 issue of *IBM Personal Systems Technical Solutions*.)

- **/CRECL:x** The *x* parameter sets the maximum record size, in kilobytes, that can be cached in one block. The permissible range for *x* is from 2 to 64; the default of 4 should be sufficient for most purposes. You might wish to adjust this size if you frequently have to access a database file that has records of 4K or larger, however.
- **/AUTOCHECK:ddd** The HPFS driver can automatically check (and fix) HPFS partitions to detect file problems or the inconsistent disk state produced by a system crash or reboot without a proper shutdown. The *ddd* represents the drive letters (without the usual following colon) of the HPFS drives you want checked, as, for example,

AUTOCHECK:CDE

Another common IFS is the OS/2 device driver for a CD-ROM drive. OS/2 ships with support for IBM and Toshiba CD-ROMs, and other vendors are slowly

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releasing drivers for their own hardware. If your CD-ROM vendor hasn't released OS/2 drivers yet, you can try the generic CD-ROM driver that IBM has released to its OS/2 forums on CompuServe and other support BBSs.

MEMORY MANAGEMENT OS/2 has a number of commands that affect the management of system memory. To a certain extent these statements are also related to system performance and so go hand in hand with the Performance commands. Proper memory management requires striking a balance between them, which I'll be covering in detail in Part 2 of this column.

DOS= This command controls whether DOS and Windows sessions have access to UMBs. It is similar to the comparable command in DOS 5.0, except that in OS/2 you *must* specify these options; there is no default value. Four settings are possible:

- **UMB, HIGH** When this is supplied as a parameter after **DOS=** it instructs the operating system to provide UMBs and load the DOS kernel into the XMS memory area.
- **UMB, LOW** This tells OS/2 to provide UMBs and to load the DOS kernel into lower RAM.
- **NOUMB, HIGH** This loads the DOS kernel in XMS but doesn't provide DOS support for UMBs.
- **NOUMB, LOW** Completing the picture, this loads the kernel into lower RAM and doesn't provide DOS support for UMBs.

Note that if the **VXMS** parameter is active in your system you must also include the **/UMB** parameter to the **VXMS.SYS** device driver. This will provide UMB support for applications that can access the UMB area.

MEMMAN= This is the most important OS/2 memory management command, as it controls how the operating system handles loading applications into system or virtual memory. The three command parameters are on/off switches to be entered in the following order on the command line. They must be separated by commas.

- **SWAP/NOSWAP** This parameter pair controls OS/2 virtual memory and tells the operating system that it may or may not swap data to disk if it needs more RAM. **SWAP** is the default, which is the appropriate choice for most users.

You're likely to need **NOSWAP** only if you're running an application that relies on critical timing, such as one that gathers real-time data.

- **MOVE/NOMOVE** This pair controls how OS/2 handles different blocks of system RAM. Whenever you close an application, the memory block it was using becomes free. After running a number of different programs, however, the system memory blocks can become fragmented. This can slow down application loading speed appreciably. The default **MOVE** parameter lets OS/2 move application memory blocks and recombine free memory into bigger blocks in order to manage the system's memory more efficiently. **NOMOVE** is required under the same circumstances as **NOSWAP**.

- **PROTECT/NOPROTECT** This option determines whether applications and DLLs can have direct access to protected memory. The default is **PROTECT**, which is the correct setting for everyone except programmers.

RMSIZE= RMSIZE sets the number of kilobytes of low RAM available to each DOS or Windows session under OS/2. The default is 640; you can set it to a lesser value (for example, 512) if your DOS programs don't usually need the full 640K to run or if you only have 4 to 6MB of RAM in the system. If you do set it lower, you can get more memory for your applications by turning on OS/2's UMB support and loading TSRs and device drivers into the UMB area with **DEVICEHIGH** and **LOADHIGH**.

THREADS= This command sets the maximum number of processes (called *threads*) that OS/2 can have active at one time. The default is 256 and this should be sufficient for most users. You will need to raise the amount (the maximum amount is 4095) if you're running a large number (20 or more) of programs simultaneously.

In the next issue we'll continue our exploration of the OS/2 2.0 **CONFIG.SYS**, covering the commands that affect performance, application configurations, and user preferences. Part 2 will also include a sample **CONFIG.SYS** file that shows the optimal performance settings for an 8MB system. □

JOE SALEMI IS A CONTRIBUTING EDITOR OF PC MAGAZINE.

Optimize Your Disk Drive Efficiency with DEFRAGR

BY BOB FLANDERS AND MICHAEL HOLMES

If your hard disk seems to be taking longer and longer to retrieve the files you work on each day, it's not a sign that your aging drive is slowing down. The culprit could be *file fragmentation*, which causes the drive head to go through a series of jumps from one track to another across the disk so that it can retrieve the separated parts of the file. Fortunately, unlike aging, file fragmentation is reversible, and that's the job of this issue's free utility, DEFRAGR.EXE.

File fragmentation is an almost inevitable consequence of normal disk usage, in which you create, delete, and modify files. If every file occupied only one cluster (the smallest amount of disk space DOS can allocate to a file—sometimes called an *allocation unit*), no file would ever become fragmented. But most files occupy many clusters, and if the clusters that contain a file are not contiguous, the file is fragmented.

For example, a three-cluster file that occupies clusters 5, 6, and 7 is not fragmented and can therefore be read without moving the drive head. Suppose, however, that DOS had to store the same file in the clusters vacated by previously deleted entries, so that the file came to occupy clusters 5, 108, and 2063. In this case the file would be fragmented, and two time-consuming head moves would be required to read it.

Keeping different parts of a file on widely separated parts of the disk does not endanger your data, but since head-moving is the slowest part of disk operation, it's obvious that fragmentation can dramatically decrease the speed at which a disk retrieves information from a file. This issue's utility, DEFRAGR, will defragment a drive's files by rearranging them so that all the clusters of each file are contiguous. That's the way to get the

best possible performance out of your drive.

You can download DEFRAGR from PC MagNet, as explained in the "Utilities by Modem" sidebar. DEFRAGR.ZIP contains both the DEFRAGR.EXE executable file and its source code. In order to recompile the source files you will need to have Microsoft C, Version 6.0 or later, or Borland C++, Version 3.0 or later.

If you don't have a modem, you can obtain the same files directly from PC

If you're not already using a satisfactory commercial disk-defragmenting utility, here's the way to bring your drive performance up to speed.

Magazine. Simply send a postcard request with your name, address, and disk size preference (360K, 720K, 1.2M or 1.44M) to the attention of Katherine West, PC Magazine, One Park Ave., New York, NY 10016-5802. Alternatively, you can fax your request to 212-503-5799. No phone calls, please!

USING DEFRAGR DEFRAGR has a very simple syntax:

```
DEFRAGR d: [/Q] [/?]
```

where *d:* tells the utility which drive to defragment, /Q causes DEFRAGR to run in "quiet" mode, and /? displays a help screen.

During its execution, DEFRAGR displays a number of drive statistics and a status line. You can disable this display

by using the /Q option. Run with /Q, DEFRAGR shows only the copyright information and a twirling bar to reassure you that the defragmentation process is proceeding.

You can stop DEFRAGR before it has finished its task by pressing the Ctrl-Break key combination. This will not endanger your data, but if you stop the utility prematurely it is possible that the drive will be left even more fragmented than when DEFRAGR started! If you restart DEFRAGR after a Ctrl-Break, however, it will continue defragmenting the drive from the point at which it previously left off. Of course, if you make changes to the drive after stopping DEFRAGR, the utility will take these changes into account when restarted. If you created or changed any files, it will defragment them. And if you deleted files, it will use the space that is now available.

FIRST THINGS FIRST Before you start, you may want to check whether your disk even needs defragmenting. You can do this by using CHKFRAG, a utility originally presented in our August 1989 issue and available on PC MagNet. CHKFRAG measures the degree of file fragmentation on a drive and returns both a recommendation for action and a corresponding DOS ERRORLEVEL code.

Since an ERRORLEVEL can easily be tested in a batch program, you can automate the task of checking and, if necessary, defragmenting your drive. For example, the following batch file, FRAG.BAT, will defragment drive C: only if ten percent or more of its files are fragmented.

```
CHKFRAG C:
IF NOT ERRORLEVEL 10 GOTO DRIVEOK
DEFRAGR C:
:DRIVEOK
```




Figure 1: DEFRAGR presents a considerable amount of information while defragmenting a drive.

Because DEFRAGR must rearrange the basic organization of your disk, it's only prudent to back up your work before defragmenting. We also recommend that you run the DOS CHKDSK command. If CHKDSK reports lost allocation units, rerun CHKDSK with its /F option to recover the disk space. But if CHKDSK reports cross-linked files or the like, you may want to use a more powerful disk repair utility to solve the problem. DEFRAGR will not run if it detects any errors in the drive's structure.

Finally, you must ensure there is at least 250K of free space on the drive. DEFRAGR will run with less free disk space than this, but it will be painfully slow. If no space is available on a drive, DEFRAGR does not proceed.

WHEN DEFRAGR EXECUTES Figure 1 shows an example of the messages that DEFRAGR displays while it executes. At start-up, the utility displays its copyright message, followed by several lines of drive information. The first line shows the drive being defragmented, the label (if any) of the drive, and the serial number of the drive. (Serial numbers were introduced in DOS 4.0. If you happen to be using a disk formatted with DOS 3.31 or earlier, no serial number will be seen.)

The Disk Info line shows the number of sectors and clusters on the drive, together with the cluster size. (Microsoft began calling clusters "allocation units" in DOS 4.0, but the older term is more familiar.) While a sector is the smallest amount of disk space that can be read or written in a single operation, a cluster (which comprises one or more contiguous sectors) is the minimum amount of

disk space that DOS can allocate to a file. The cluster size, of course, is the number of bytes in a single cluster. This will vary according to size of the drive and the version of DOS used to format it.

The Capacity line describes the disk space utilization. The first number is the total space on the drive, followed by the space used, and finally, the space still available.

DEFRAGR then displays two lines that describe what must be done to defragment the drive and how much memory is available to be used. The first number on the To Be Moved line indicates the number of clusters that must be relocated in order to defragment the disk. The second number indicates the number of files and directories on the drive. The Memory line shows the number of cluster buffers available and the size of the directory cache. (DEFRAGR holds disk sectors containing directory entries in the directory cache so it can access them quickly.)

DEFRAGR uses the Status line to report its progress. This line contains a bar graph, the completion percentage, the number of clusters moved to their final position, and the number of clusters shifted to a temporary location. The line also indicates which DEFRAGR operation is currently underway.

The bar graph presents a graphic representation of DEFRAGR's progress. Starting as a solid thick line made up of ASCII 219 characters, the graph gradually changes, from left to right, into a line composed of dot-filled boxes (ASCII 177 characters). Simultaneously, the percentage of completion value following the bar graph progresses from 0 percent to 100 percent. When the bar graph is all dots and the percentage is 100, DEFRAGR has completely defragmented your drive.

The final value indicates the number of clusters that have been moved. As with the other indicators, when this value equals the number of clusters shown on the To Be Moved

line, defragmentation is complete.

Similarly, the temp value shows the number of clusters currently housed in a temporary holding position. DEFRAGR moves a cluster to a temporary position when that cluster occupies another cluster's projected final position. (This is why a drive must have some free space. DEFRAGR uses free space as a temporary work area during the defragmentation process.)

The final screen message during DEFRAGR's operation—shown as Update in Figure 1—cycles through four values: Search, Read, Write, and Update. During the Search operation, DEFRAGR determines which clusters to move next and where to move them. During the Read and Write operations, the utility reads and writes these clusters. During the Update operation, DEFRAGR updates the disk's structure to reflect the changes in location.

Unfortunately, missing from the status line is a countdown timer, an indicator that would show the time left until completion. Although we tried to implement one, we found it inaccurate because it proved impossible to predict how many clusters DEFRAGR would shift to a temporary location before moving them to their final positions.

When DEFRAGR finishes, it replaces the status line with some final statistics that show how it used the directory cache, how well it performed, and how long DEFRAGR was active. Figure 2 is an example of DEFRAGR's final screen, which is of interest primarily if you want to know how efficiently DEFRAGR executed its task.

On the Cache Stats line of Figure 2,



Figure 2: After completely defragmenting a drive, DEFRAGR presents this final report.

the first value is the number of directory cache sectors actually used by DEFRAGR. The "hits" value indicates the number of times DEFRAGR needed a directory sector and found that sector in the cache. Similarly, the "misses" value indicates the number of times DEFRAGR did not find a needed sector in the cache and had to replace a used cache entry with the required sector. Finally, "forced writes" indicates the number of times DEFRAGR replaced a used cache sector, but wrote the sector to disk first. A forced write occurs when DEFRAGR needs a directory sector not already in the cache and all of the used cache entries have not yet been written to disk.

The Finished line displays the total number of clusters moved, including the clusters that had to be moved to and from the temporary area. Also on that line is a performance indicator showing the number of clusters and bytes moved per second. Before returning to DOS, DEFRAGR displays its total execution time on the Elapsed line.

RESTRICTIONS In addition to making a backup for your protection, there are a few restrictions you should observe when using DEFRAGR. First, you should not run DEFRAGR under Windows, the DOS 5.0 DOSHELL, or any other multitasking system. While DEFRAGR is in operation, much of the information that usually resides on the disk drive is held in memory instead. This could cause data loss if a multitasking system is in operation.

DEFRAGR maintains a copy of the FAT (file allocation table) in memory, for example, and it updates the copy on disk only when necessary. Since other tasks in a multitasking system don't have access to DEFRAGR's copy of the FAT, however, they can't determine the current status of the disk. Files read from the disk may no longer reside in the location indicated by the disk-based FAT, for example, and files that another task writes to the disk may be lost when DEFRAGR updates the FAT from the copy in its own memory. For these reasons, if you attempt to run DEFRAGR in a multitasking environment, you'll get an error message, and DEFRAGR will then return to DOS.

You must take care not to redirect the output from DEFRAGR to the drive be-

■ Utilities by Modem

The *PC Magazine* utilities are available by modem from PC MagNet, a ZiffNet service hosted by CompuServe.

To find the phone number nearest you, set your communications software to 300, 1,200, 2,400, or 9,600 bits per second, 7 data bits, even parity, 1 stop bit, and full duplex, then dial 800-346-3247 with your modem.

When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the number closest to you. Or you can call 800-635-6225 (voice) and follow the instructions and note the number.

To obtain the current issue's utility free of charge: Dial the local number; at the HOST NAME prompt, type CIS; and at the USER ID prompt, enter 60116.1. Then at the PASSWORD prompt, enter PCMAG-UTIL.

To join ZiffNet: At the USER ID prompt, type 177000,5000. Then, at the PASSWORD prompt, enter PC* MAGNET. Finally, at the ENTER AGREEMENT NUMBER prompt, type PCMAG93.

ing defragmented. When you redirect output, DOS opens and writes to the requested file. As with multitasking, DOS does not know the current status of the drive, so it cannot write to the drive safely. If you redirect output to the drive being defragmented, it may result in damage ranging from loss of data to destruction of subdirectories.

DEFRAGR will not try to move files that are marked hidden, system, or read-only. This is because some such files—system files under DOS 3.3 and files used in some copy-protection schemes—are very position-dependent. For example, under MS-DOS 3.3, the files MSDOS.SYS and IO.SYS (the files that actually contain DOS) must not be moved; the disk becomes unbootable if they are. DOS marks these files as hidden, system, and read-only, so DEFRAGR (and most, if not all, other defragmentation utilities) will not touch

them. DEFRAGR rearranges only directories and normal files. This may, however, cause a normal file to be split into two fragments.

Of course, you could use this restriction to your advantage in the unusual case where you do not want a file to be moved. By simply marking the file read-only with the DOS ATTRIB command, you can ensure that DEFRAGR will leave the file in its original position.

Before defragmenting, you must deactivate or unload from memory any TSR (terminate and stay resident) programs that access or modify the disk to be defragmented. An example of such a TSR is BACKDOWN (presented in the May 12, 1992, issue), which downloads files in the background from a communications service onto a disk. As with multitasking software, the TSR may read invalid data or overwrite existing files. If you're not sure about a TSR, you may want to take

Register your name and enter your American Express, MasterCard, or Visa number. (If you'd like to have your company billed instead, simply call CompuServe at 800-848-8990.) Your personal user ID and a temporary password will be displayed. A new password will arrive in the mail within ten days to confirm your subscription.

ZiffNet membership costs \$2.50 per month. This includes access to *PC Magazine* Editors' Choice awards, Product Reviews Index, Weekly News from *PC Week*, Buyers' Market, ZiffNet Highlights, and the Support Forum (which also includes the current utility). CompuServe members can join by entering GO PCMAG at any CompuServe ! prompt.

Outside of these areas, PC MagNet costs \$6.30 per hour for 300-bps service; \$12.80 for 1,200 or 2,400 bps; and \$22.80 for 9,600 bps. Billing is based on 1-minute increments.

These programs can be copied but are copyrighted. You may make copies for others as long as no charge is involved, but making copies for any commercial purpose is prohibited.

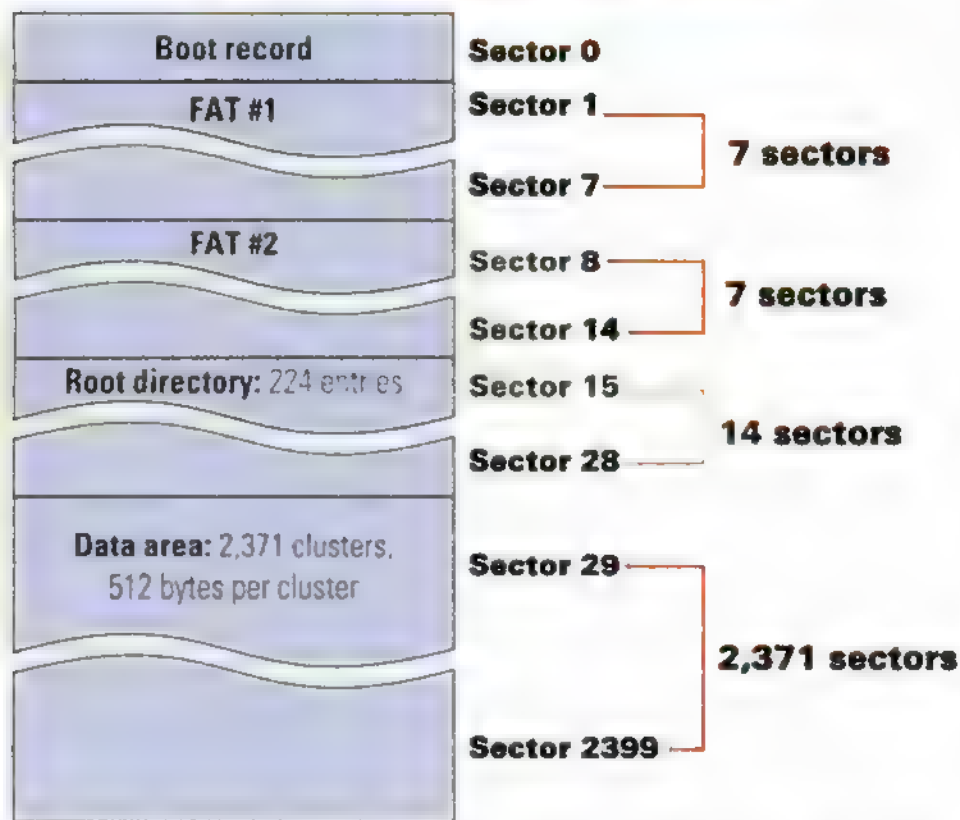
DOS 1.2MB Floppy Disk Layout

Figure 3: This graphical layout of a 1.2MB floppy disk shows the four areas common to all formatted DOS disks: the boot record, in sector 0; two FATs, starting in sector 1; the root directory, after the last copy of the FAT; and the data area, which directly follows the root directory.

the safe route and disable it while defragmenting a disk.

One notable exception to the rule about removing TSRs concerns disk-caching software. DEFRAGR has been tested under SMARTDRV (supplied with Windows 3.1 and DOS 5.0) and is likely to run with most commercially available caching programs.

The one function provided by many caching programs that *could* cause difficulty is write caching. When a cache program uses delayed writes, it holds writes to the disk in memory for a short period of time before actually writing them to the disk. Unfortunately, this feature will mislead DEFRAGR, representing that a disk write has been completed when, in fact, the write has not even started. Should your system crash while data is still in the write cache, files may be damaged. You should therefore disable any write-caching feature before defragmenting a drive.

If you are using SMARTDRV 4.0 (or later), you can check if write caching is enabled by invoking the command SMARTDRV /S. When executed with /S, SMARTDRV displays several statistics, including the caching status of each drive. Write caching is enabled for a drive if the entry under "write cache" is "yes."

To disable write caching, you simply

enter the command SMARTDRV d, where *d* represents the drive that you plan to defragment. After defragmenting the drive, the command SMARTDRV d+ will reenab

SUPERPCK /F/D

le write caching for that drive. Of course, it's possible to completely disable both read and write caching for a drive if you use the command SMART-DRIVE d-.

SUPERPCK /E

If you don't know the command to disable your cache software, you can temporarily REM out the command that invokes it in your AUTOEXEC.BAT file or your CONFIG.SYS file and reboot your machine. Alternatively, you can boot up from an appropriately configured floppy disk before defragmenting your system.

FRAGMENTATION Before we explore how DEFRAGR works in detail, we'll take a closer look at fragmentation and why it slows your system. As mentioned earlier, a file is fragmented when it spans noncontiguous clusters. To understand how this happens, we must first look at the DOS drive structure.

Every DOS drive contains at least four—and possibly five—areas: the boot

sector, the reserved sectors, the FAT, the root directory, and the data area. The boot sector contains such configuration information as number of sectors, number of clusters, number of sectors in a cluster, and so on. The boot sector contains a short program that is executed should the system be booted from that disk. Officially, the boot sector is considered the first reserved sector, as noted in the *Microsoft MS-DOS Programmer's Reference* for DOS, Version 5.0.

In unusual cases a DOS drive may contain additional reserved sectors, although we have never in fact encountered such a disk. In such a case, the reserved sectors field of the boot record will be set to a value greater than 1. Any additional reserved sectors directly follow the boot sector.

The file allocation tables, or FATs, immediately follow the reserved sectors. Information contained in the FAT describes where files reside on the disk. Usually, a DOS drive contains two copies of the FAT.

Immediately following the FAT comes the root directory. DOS creates a root directory whenever you format a drive. The root is the top level of the directory structure.

Finally, the data area is the portion of the disk that actually contains the files and subdirectories. DOS divides the data area into a set of equal-size units called clusters. Every file that contains even one byte occupies at least one full cluster. Figure 3 shows the layout of a 1.2M floppy disk. While items such as FAT size, root directory size, and cluster size may differ, the general layout of a hard drive is the same as that shown in Figure 3.

DOS files (when greater than zero length) comprise three items: a directory entry, one or more FAT entries, and one or more clusters. (Zero-length files consist of a directory entry, nothing more.) To get to the information in a file, DOS starts by reading the file's directory entry. The directory entry contains the first cluster number of the file.

Of course, when you issue a DOS DIR command, the cluster number doesn't show up on the screen. That's simply because the DIR command does not display all the information the directory entry contains. There are actually two undisplayed items: the file attributes and the

first cluster of the file. But DOS needs the first cluster number from the directory entry in order to determine where a file resides on a drive. And if the file is larger than one cluster, DOS must then use the FAT to determine which is the next cluster.

The FAT is an array of integers, with all entries being either 12 bits or 16 bits wide. If a disk contains more than 4,086 clusters, it uses a 16-bit FAT; otherwise, it uses a 12-bit FAT.

Each FAT entry may contain one of four values:

- a zero indicates that the cluster is not in use by any file;
- a valid cluster number indicates the next cluster allocated to an associated file;
- an entry of FFFh or FFFFh indicates the last cluster in the chain of clusters used by a file—DOS recognizes FF7h to FFFh (12-bit FAT) or FFF8h to FFFFh (16-bit FAT) as the end of the file indicators, but only uses FFFh or FFFFh when it updates the FAT;
- or either the value 0xFF7 (for a 12-bit FAT) or 0xFFFF7 (for a 16-bit FAT) indicates that the cluster has a bad spot on the disk and can't reliably contain data.

Any other value in a FAT entry constitutes an error in the disk's structure.

Thus, if you use a file's first cluster number to access the value from the FAT entry, the value should be either another valid cluster number (the next cluster of the file) or an end-of-file indicator (all 1-bits). Any other value indicates an error in the FAT. DOS uses this process to read through the whole file.

When DOS creates a file, it first adds the directory entry to the requested directory. Then, as data is added to the file, it updates the FAT, showing which clusters are being used by the file. By its very nature, a one-cluster file cannot be fragmented. But if the cluster immediately following the first (or any) cluster of a file is in use by a different file, DOS must allocate other, nonsequential clusters for subsequent data in the file, and the file immediately becomes fragmented. Figure 4 shows the relationship between a directory entry, the clusters, and the FAT for the fragmented file DATA.FIL.

As indicated earlier, moving the read/write heads is the slowest operation that disk drives perform. The more the read/write heads have to move, the longer it

takes to transfer data to or from the drive. On the other hand, if all of the data resides in sequential, contiguous clusters, the head movement is reduced or eliminated and the file is transferred with the maximum efficiency.

So, to minimize head movement, all you have to do is pull the parts of the file together. That seems easy enough, but to arrange the fragmented parts of the file sequentially, portions of other files must be moved out of the way and themselves sequentially united. The process is more complicated than you might imagine, but DEFRAGR does it safely and quickly.

INSIDE DEFRAGR - When designing DEFRAGR, we laid down two rules and two goals. Rule 1 was that no harm should come to the data on the drive as the result of a system crash during a defragmenting operation. Data safety was to be provided even if there was a power outage or the user shut off the machine. (Of course, DEFRAGR cannot prevent any damage resulting from the failure of the hard disk, the disk controller, or other faulty hardware components.) Rule 2 was that the user must be able to stop DEFRAGR prematurely by pressing Ctrl-Break. When this key combination is pressed, the utility shuts down gracefully with the disk structure intact.

Similarly, we had two goals. First, DEFRAGR had to be fast. Testing shows it is on a par with or better than many commercial defragmentation utilities. Second, DEFRAGR should be informative. As outlined earlier, DEFRAGR displays a significant amount of information be-

DOS Disk Components

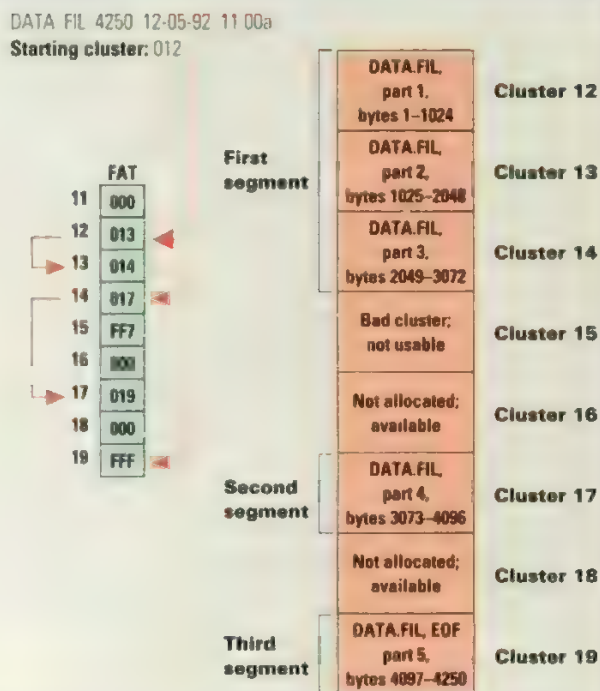


Figure 4: The diagram above depicts the relationship among the directory, FAT, and clusters of a file. The boot record for the drive in this example indicates 512 bytes per sector and two sectors per cluster, for a 1,024-byte cluster size. In addition, the directory entry shows that DATA.FIL's size is 4,250 bytes, and the first cluster is 12. Additional clusters are 13, 14, 17, and 19. From this you can infer that DATA.FIL consists of five clusters and that the file is fragmented. Note that the last 870 bytes of cluster 19 are not used by the file, but the space is allocated to DATA.FIL. There is no standard way for this space to be used by another file.

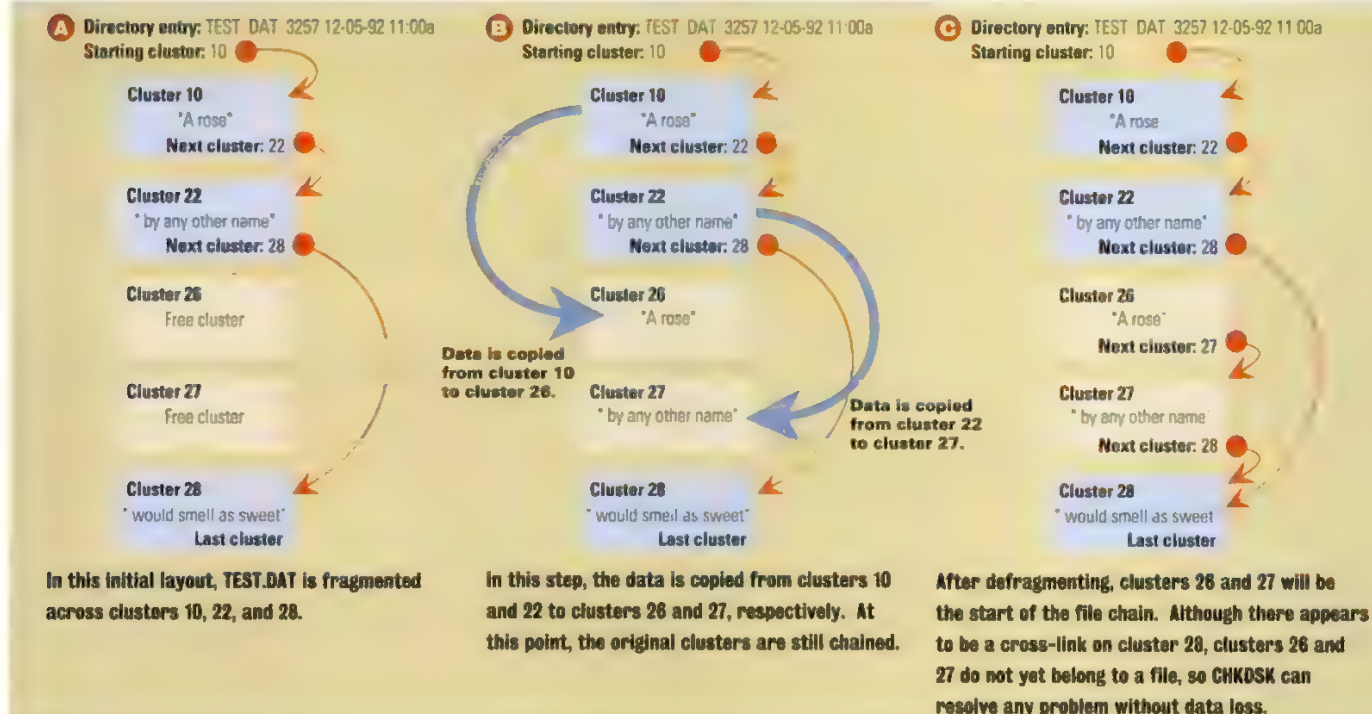
fore, during, and after a defragmentation run. Its source code is also well structured and well documented.

To fulfill these rules and meet these goals, we came up with an algorithm that uses four steps when updating the drive.

- Step 1: First, DEFRAGR copies data in allocated clusters to unallocated clusters (free disk space). At this point, only DEFRAGR knows which clusters contain the copies, for the directory and FAT have not yet been updated. Part A of the diagram "How DEFRAGR Works" shows an initial layout of a fragmented file, TEST.DAT. Also shown are two free clusters immediately preceding the last cluster of TEST.DAT.

Part B shows this first step in action. The contents of clusters 10 and 22 are copied to clusters 26 and 27, respectively. Although the data has been copied, the FAT thinks that clusters 26 and 27 are

How DEFRAGR Works



still free, and as long as DEFRAGR writes only on free disk space there is no chance of overwriting data in a file. Of course, on disks with only a small amount of free space, DEFRAGR must move the data in smaller portions, and this usually prolongs DEFRAGR's execution time.

• Step 2: In this step, the FAT entries for the just-copied-to clusters are updated to reflect the new allocation chain of the file. To assure that no data is lost, the old clusters are not yet deallocated in the FAT itself. Part C of the diagram shows the result of updating the FAT so that *both* chains—clusters 10, 22, and 28 and clusters 26, 27, and 28—now reside in the FAT.

Having these two chains gives the appearance of causing a major problem: the dreaded cross-link error, in which two files occupy the same disk space, that is, cluster 28. Fortunately, this is not actually the case, for clusters 26 and 27 are not yet part of any file known to DOS. Thus, if you interrupted DEFRAGR immediately after it rewrote the FAT in this state, CHKDSK /F would simply report two lost allocation units, and then would free clusters 26 and 27 (or create FILEnnnn.CHK with those two clusters). The file TEST.DAT would remain intact.

• Step 3: Here, as shown in part D of the diagram, the directory entries for the affected file are updated to reflect the new starting cluster (26) of the file. Still intact, TEST.DAT now occupies clusters 26, 27, and 28, and in case of mishap CHKDSK would regard clusters 10 and 22 as lost allocation units.

• Step 4: Finally, the FAT entries that reflected the old position of the file are updated and the FAT is rewritten to disk. Thus, in part E of the diagram, the FAT entries for clusters 10 and 22 are set to zero, freeing these clusters for other uses. Of course, the data contained in these clusters has not changed, but as the defragmentation process continues, the contents of clusters 10 and 22 are likely to be overwritten.

DEFRAGR IN ACTION When DEFRAGR starts, it performs such standard house-keeping chores as displaying the copy-right, scanning the command line, and verifying arguments. In preparation for the defragmentation process, it also reads the FAT into memory and builds an in-memory copy of the directory structure. Finally, DEFRAGR scans the FAT to make sure that no cross-links or lost allocation units are found. If any errors are detected in the FAT, DEFRAGR issues

an appropriate error message and returns to DOS.

Next, DEFRAGR allocates the remaining conventional memory to be used for cluster buffers and a directory sector cache. DEFRAGR uses the cluster buffers when reading clusters that it wants to move. The directory sector cache is a true cache that uses a least-recently used (LRU) algorithm. When DEFRAGR needs a directory sector, it checks first to see if the sector is already in the cache.

Before starting the defragmentation process, DEFRAGR fills in a structure we call the reverse FAT. For each entry in the FAT there is a corresponding entry in the reverse FAT that contains the final, ultimate location of the corresponding cluster. In other words, DEFRAGR calculates the final resting place for every allocated cluster on the drive before anything is moved.

To calculate each file's final location, DEFRAGR scans the disk's directory structure twice. During the first scan, DEFRAGR selects directory entries, assigning final locations starting in the lowest-numbered clusters. During the second scan, DEFRAGR selects the normal (not system, hidden, or read-only) files, assigning those files final locations



files, assigning those files final locations following the subdirectories. DEFRAGR offers no other defragmentation strategy.

To fill in the reverse FAT, DEFRAGR scans the directory structure and assigns an ultimate location for each cluster in a file. Reverting to part A of the diagram, the reverse FAT entries for clusters 10 and 22 would indicate the ultimate locations as cluster 26 and 27, respectively. Cluster 28, on the other hand, would be marked as being already in its ultimate location.

Once the reverse FAT is filled in, DEFRAGR begins the actual defragmenting process. This consists of simply repetitively performing the four steps outlined above until the disk is organized. To recap the steps: Move some clusters, perform the initial update of the FAT, update the directories, and make the final update of the FAT.

Before actually reading the clusters, DEFRAGR first searches the reverse FAT for clusters to be moved and tries to find a place to move them. As the clusters are found, DEFRAGR builds a read list of the clusters to be read. If possible, these clusters will be moved to their ultimate locations in one step. If that is not

possible, they will be moved to a temporary area until their ultimate locations become available.

DEFRAGR considers a read list complete when (a) all cluster buffers are reserved for a cluster, or (b) all the free space is assigned, or (c) there are no more clusters to move. Of course, once all the clusters are in their ultimate locations, DEFRAGR's job is done, and the utility returns to DOS after printing a final report.

DEFRAGR then reads the clusters specified in its read list into memory. Before performing an actual read, however, it checks the read list for sequential clusters. This determines whether it can read more than one cluster at a time. Whenever possible, DEFRAGR reads multiple clusters with a single DOS request, since this reduces the overhead (including device driver and BIOS calls) associated with multiple DOS calls.

After reading the clusters on its list, DEFRAGR writes them to the appropriate locations on-disk. As with the read operation, DEFRAGR scans the write locations for sequential clusters, issuing single write requests where possible.

UPDATING THE DRIVE'S STRUCTURE Although file and directory contents have

been moved to new clusters, the FAT and directory entries have not yet been updated to reflect the changes. Thus, as explained above in discussing DEFRAGR's four-step algorithm, the next operations formalize the changes.

DEFRAGR starts by allocating the new clusters in the FAT. A single-file illustration of this procedure was shown above in part C. Since in actual practice possibly hundreds of clusters may have been moved, there is the possibility that many lost clusters will be left on the disk should an unexpected interruption occur. Nevertheless, CHKDSK can easily repair all such errors, if necessary.

If any moved cluster is the first cluster of a file, the corresponding directory entry must also be updated. In such a case, DEFRAGR also updates the starting cluster field in the affected directory entries.

The . and .. entries in a subdirectory are an unusual feature of the DOS disk structure. The . entry refers to the current subdirectory, and the .. entry refers to the parent directory. DEFRAGR takes special note of clusters that are the first cluster of a directory. When these clusters are moved, DEFRAGR must update not only the directory entry for the cluster itself, but the . entry in the directory itself, and the .. entries in all child directories, as well.

Finally, after updating the directory entries and writing them to disk, DEFRAGR clears the FAT entries for the old locations of the clusters and rewrites the FAT. Once this operation is complete, even if DEFRAGR were interrupted, the disk structure would remain intact, with no structural errors or lost clusters. DEFRAGR continues to build read lists, and process these lists, until all clusters have been moved.

DEFRAGR demonstrates several techniques needed to analyze the structure of a DOS disk, rearrange that structure for optimal performance, and perform these operations quickly and safely. And programmers will appreciate that it is possibly the only defragmentation utility that includes the source code. □

BOB FLANDERS IS PRESIDENT AND SENIOR SYSTEMS ANALYST AND MICHAEL HOLMES IS VICE PRESIDENT AND SENIOR SYSTEMS ANALYST AT NCI SYSTEMS IN ANNANDALE,

What Can We Do With OS/2 Bitmapped Fonts?

BY CHARLES PETZOLD

W

orking with fonts under a graphical environment such as the OS/2 2.0 Presentation Manager is a multistep process. You must first determine what fonts are available and then figure out how to get access to them. Once you can display lines of text using a particular font (I've demonstrated how to do this in the last several issues), you'll naturally want to do a little more. Graphics programming is much more fun if you can make the fonts perform some magic tricks and dance around a little!

Some fonts are more agile and limber than others. Specifically, outline fonts are great dancers and magicians; bitmapped fonts are almost total clods.

Nevertheless, I've decided to look at bitmapped fonts, as implemented under the OS/2 Graphics Programming Interface (GPI), before exploring outline fonts. While bitmapped fonts may be clunkers in some ways, they *do* have some advantages. In terms of raw performance, bitmap fonts can be displayed more quickly than outline fonts. In theory—and often in practice—bitmapped fonts also look a little better on the screen. So, for the display of simple text on the video display with normal font sizes and attributes, there is absolutely no reason *not* to use bitmapped fonts.

We've already explored how to enumerate all the bitmapped fonts available for the video display and how to select them with attributes such as boldface, italic, underscore, and strike-out. Now it's time to go beyond the basics.

TEXT AND BACKGROUND COLOR Nothing makes a word stand out more on the screen than a different color. There are two ways to change text color. The easiest approach is to use:

```
GpiSetColor (hps, clr) ;
```

where *clr* is normally a constant that begins with the prefix CLR. The PMGPI.H header file defines CLR constants for the default text and background colors and for the 16 standard colors available on the VGA. You use:

```
GpiSetBackColor (hps, clr) ;
```

to set the background color, which is the color that GPI uses to fill in the background of the text box. Normally, however, the background color is not drawn because the default background mix mode (which you can set using *GpiSetBackMix*) is BM_LEAVEALONE. You

*Although outline fonts
are today's norm, bitmapped
fonts can provide faster
display speed and
surprising versatility.*

can also set a foreground mix using *GpiSetMix*. This determines the raster operation GPI uses to combine the pixels of the text characters with the pixels already on the surface of the output device.

The *GpiSetColor*, *GpiSetBackColor*, *GpiSetMix*, and *GpiSetBackMix* functions affect *all* GPI primitives: lines, areas, images, markers, and text. If you'd rather set color and mix just for text, you'll have to use the *GpiSetAttrs* function, which I'll describe briefly towards the end of this column.

TEXT DIRECTION In the last issue I mentioned *GpiSetTextAlignment*, which supposedly lets you change how GPI interprets the coordinate point you specify

when displaying a character string. Normally, GPI aligns text so that the baseline of the left side of the first character is at the coordinate point. *GpiSetTextAlignment* is documented as able to change the meaning of the specified point. That is, the *y* coordinate could refer to the top, bottom, or center of the character (rather than the baseline), and the *x* coordinate could refer to the right or center of the string (rather than the left).

As I also mentioned, however, *GpiSetTextAlignment* is apparently not yet supported in OS/2 2.0. Fortunately, another somewhat-related function called *GpiSetCharDirection* is supported. That function has the following syntax:

```
GpiSetCharDirection (hps,  
lDirection) ;
```

where *lDirection* can be one of five constants: CHDIRN_DEFAULT, CHDIRN_LEFTRIGHT, CHDIRN_RIGHTLEFT, CHDIRN_TOPBOTTOM, or CHDIRN_BOTTOMTOP.

CHDIRN_LEFTRIGHT is normal. The coordinate point you specify when displaying the string refers to the baseline at the left side of the first character, and the characters are displayed from left to right.

With CHDIRN_RIGHTLEFT, the coordinate point you specify when displaying the string refers to the baseline at the *right* side of the first character, and the string is displayed from right to left. The actual appearance of each individual character is normal (that is, the characters are not flipped around), but the character string is displayed in reverse. Thus, the character string "abc" looks like "cba."

With the CHDIRN_TOPBOTTOM function, the coordinate point specified when displaying the string refers to the center of the top of the first character,

and the string is displayed going down the screen. With `CHDIRN_BOTTOMTOP`, the point refers to the center of the bottom of the first character, and the string is displayed going up the screen, from first character at the bottom to last character at the top.

At first, changing character direction doesn't appear to be very useful unless you're working with languages that are read from top to bottom or from right to left. However, you'll probably find a need for the `CHDIRN_TOPBOTTOM` function when you're displaying text that identifies a vertical axis of a graph or something similar.

RIGHT-JUSTIFYING TEXT `CHDIRN_RIGHTLEFT` is also useful, specifically when you need to right-justify text, as in displaying a column of variable-length numbers so that they line up correctly on the right.

Let's assume that `szText` is a pointer to the zero-terminated text string you want to display in a right-justified format. Let's also assume that you've initialized a `POINTL` structure that contains the *x* and *y* coordinates at which you want the baseline of the *right* side of the string to appear. Now switch to a right-to-left character direction with:

```
GpiSetCharDirection (hps,
    CHDIRN_RIGHTLEFT) ;
```

But don't display the text just yet, however, for the character sequence will be in reverse! That problem is easily taken care of by using a C library function commonly supported by C compilers:

```
strrev (szText) ;
```

The `strrev` function simply reverses the order of characters in a string. (Unfortunately, `strrev` is not part of the ANSI C standard, and in order to use it with the IBM C Compiler you have to compile with the `-Sm` flag and have the migration libraries installed.)

Now you can display the following string:

```
GpiCharStringAt (hps, &ptl, strlen
    (szText), szText) ;
```

There is another way to right justify text, of course. You could call `GpiQueryText-`

`Box` to determine the width of the string and then subtract this from the *x* coordinate that indicates where you want the text to end. This also yields the *x* coordinate where the text should begin. But there's a certain elegance in using `GpiSetCharDirection` and `strrev` that I find quite appealing.

PROOF AND DRAFT MODES Although I've been emphasizing the use of bitmapped fonts only for text that appears on the screen, you can also use them for text

*The OS/2 GPI supports
switching between proof
mode and draft mode
in a way that is very
confusing at first, but that
turns out to be quite
elegant and versatile.*

on the screen that will eventually be printed. I know this sounds like a reversion to more primitive graphical environments that did not support outline fonts on the video display, but it still makes sense from a performance viewpoint.

You could, for example, give the user of your application an option to work in proof mode or in draft mode. For the former you would use an outline font on the screen that imitates precisely what will be printed. For draft mode you'd use bitmapped fonts that may only come close to the printed output. It's likely that your users might prefer the speed advantage of bitmapped fonts when typing large amounts of text and then want to switch into proof mode for final formatting and touch-ups.

The OS/2 Graphics Programming Interface supports this concept in a way that's confusing at first, but that turns out to be elegant and versatile. Basically, GPI supports *three* modes, not simply draft or proof. Let's call them draft, semiproof, and proof. Selection among them is governed by an attribute of the presentation space known as the "character mode," which you set using the `GpiSetCharMode` function. Let's see how this works.

ANGLE AND SHEAR Displaying bitmapped fonts from right-to-left, top-to-bottom, or bottom-to-top is fairly easy for GPI because the appearance of the characters is not being changed. One function that *would* be difficult for GPI to implement for bitmapped fonts is

```
GpiSetCharAngle (hps, &grad) ;
```

For an outline font, this function can be used to tilt a character string so that it runs (for example) on a diagonal up or down the screen. The second parameter is a pointer to a structure of type `GRADIENTL`, which has two fields, *x* and *y*.

These two fields define a point that indicates the angle of a line drawn from an origin of (0,0) to the point. The angle of this line determines the angle of the baseline of any subsequently-drawn text. The tangent of the angle of the baseline (measured going counter-clockwise from the horizontal) is the ratio of *y* over *x*. The default character angle is the point (1,0).

For GPI to implement this function for bitmapped fonts, the actual bitmaps that make up each character would have to be rotated.

Is there a compromise? Think about it. Perhaps without rotating the individual characters the text string could still have a diagonal baseline, with each of the characters in the string standing upright. It might look a little odd, but it would approximately illustrate what would be displayed by using an outline font.

By default, however, GPI ignores any character angle when a bitmapped font is selected into the presentation space. To change this behavior, you must call

```
GpiSetCharMode (hps, CM_MODE2) ;
```

The default character mode is `CM_MODE1`, which I alluded to above as draft mode. Given this default, GPI ignores the character angle for bitmapped fonts. However, when you set `CM_MODE2`—which you can think of as "semiproof"—for a bitmapped font, GPI will use the character angle to define a tilted baseline on which each character in the string is displayed upright. According to IBM's documentation, if you set `CM_MODE3` (full proof mode) when a bitmapped font has been selected in the

presentation space, you'll get an error. That's not entirely correct, however. If the default system font has been selected into the presentation space, then switching to CM_MODE3 will cause GPI to replace the bitmapped system font with an outline font and display rotated characters on a tilted baseline.

Incidentally, the character mode is irrelevant when an outline font has been selected into the presentation space. Overall, then, you can't simply use GpiSetCharMode to switch transparently among draft, semiproof, and proof modes: you also have to switch between bitmapped and outline fonts. The point is that you're not entirely stuck with one extreme or the other. You can make the display of bitmapped fonts come a bit closer to the display of outline fonts.

A function that GPI treats similarly to GpiSetCharAngle is

```
GpiSetCharShear (hps, &pt1) ;
```

Character shear refers to the tilting of characters to the right or left. Characters tilted somewhat to the right have an italic or oblique look, and character shear simply generalizes this idea. Like the GpiSetCharAngle function, the second parameter defines an angle from the origin. This is the shear angle, which is measured clockwise from the vertical. The point (0,1) is the default.

If the CM_MODE1 character mode is set for a bitmapped font, GPI will ignore the character shear. Although GPI will not shear bitmapped fonts in CM_MODE2, in other ways it makes it *seem* as if the characters had been sheared. For example, the rectangle returned by the GpiQueryTextBox function will indicate a tilted text box—a parallelogram rather than a rectangle.

TEXT AND CHARACTER BOXES I just mentioned the *text* box, which should not be confused with the *character* box (which I'll come to shortly). The text box is the parallelogram that encloses a particular text string displayed with a particular font. You obtain the coordinates of the text box using GpiQueryTextBox.

In addition to GpiQueryTextBox, there's a GpiSetTextBox function and also a GpiQueryDefTextBox (default text box) function. The text box is essential for working with outline fonts be-

```
FONTMETRICS fm ;
SIZEF sizef ;
.....
GpiQueryFontMetrics (hps, sizeof (fm), &fm) ;
sizef.cx = MAKEFIXED (fm.lEmInc, 0) ;
sizef.cy = MAKEFIXED (fm.lEmHeight, 0) ;
GpiSetCharBox (hps, &sizef) ;
```

Figure 1: Use this code to obtain and set the character box height and width for a bitmap font in CM_MODE2.

cause that's the way you define the font size (as we'll see in a future column). However, you can also use the text box with bitmapped fonts. Indeed, if you use CM_MODE2 with anything other than the default system font, you *must* use GpiSetCharBox to get proper character spacing.

The text box is the same thing as the em-square (sometimes also called an em-quad) for a particular font. The height and width of the em-square is the point size of the font. You'll recall that the height and width of the em-square is available in the lEmHeight and lEmInc fields of the FONTMETRICS structure. Normally, the lEmHeight and lEmInc fields are equal in terms of physical units. But if the horizontal and vertical resolutions of an output device are not equal—as is the case with the EGA—then lEmHeight and lEmInc will reflect that. You can use the GpiSetTextBox function to set a font size that uses an em-rectangle rather than an em-square. This would give you character widths that are narrower or wider than normal.

The character box is a whole different concept. You can obtain the dimensions of the default character box by calling GpiQueryDefCharBox:

```
GpiQueryDefCharBox (hps, &size1) ;
```

The second parameter is a pointer to a structure of type SIZE1, which has two fields: cx and cy. The function returns the size of the default character box in world coordinates. In physical units, the default character box never changes for a particular output device; it is based on a 10-point font. Thus, on a VGA (which has a font resolution of 96 dpi), the default character box is 13 pixels square. That's 10 points times 96 pixels per inch, divided by the number of points in an inch (72),

rounded to the nearest integer.

You can set a new character box size by calling

```
GpiSetCharBox (hps, &sizef) ;
```

The second parameter is a pointer to a structure of type SIZEF. Like the SIZE1 structure, the two fields of the SIZEF structure are named cx and cy. However, they are treated as fixed-point numbers with an integer part in the high word and a fractional part in the low word. You can convert SIZEF values to floating-point values by dividing by 65536.0. The current character box set in a presentation space can be obtained by calling

```
GpiQueryCharBox (hps, &sizef) ;
```

Here's the important point: After selecting a bitmapped font into a presentation space in CM_MODE2 (semiproof), you should obtain the lEmHeight and lEmInc fields of the FONTMETRICS structure by calling GpiQueryFontMetrics. You can then set the proper character box size. The code for this operation is shown in Figure 1.

Keep in mind that you don't have to go through this process for the default case when working with bitmapped fonts; only when you set the character mode to CM_MODE2 in order to use semiproof character angles and shears. The code in Figure 1 ensures that character spacing is appropriate for the font and will not be based on the default character box, which assumes the 10-point font size.

You are not restricted to using GpiSetCharBox in this way to fix the character box for a particular font size. If you want to give the user full freedom in selecting the point sizes of bitmapped fonts, you can use GpiSetCharBox to set the desired point size.

To illustrate how this would work, suppose the user wants to use a 36-point Helv bitmapped font. You'd actually select the 24-point bitmapped Helv font (the largest available size) into the device context, but you'd then set the character box to values 50% higher than the em-square appropriate for the 24-point font. With CM_MODE2 selected, GPI will use that 36-point character box to space individual characters horizontally and to calculate the text box, which you would use

***The GpiSetAttrs function
is not that easy to use, but
it's pretty versatile. With
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any attribute or return
it to its default value.***

for spacing lines of text. Of course, the character spacing will look a bit wide for the 24-point font, but it would come close to what you'd get with an outline font.

SETTING BULK TEXT ATTRIBUTES In this column and previous columns we've looked at several attributes that pertain to fonts:

- the foreground and background color and mix;
- the character set;
- the character mode;
- the character box, angle, and shear; and
- the character direction.

You can change some or all of these attributes at once by using the GpiSetAttrs function. The function is not that easy to use, but it's pretty versatile. With one function call, you can set any attribute or return it to its default value. You can also define what GPI thinks of as default attributes with the GpiSetDefAttrs function.

There are still a few more text-related functions that you can use to space the characters in a line of text precisely, and to add or subtract more inter-character or break-character spacing. While these options are probably more versatile than you need, they are extremely useful for justifying paragraphs of text. That's what we'll look into in the next issue. □

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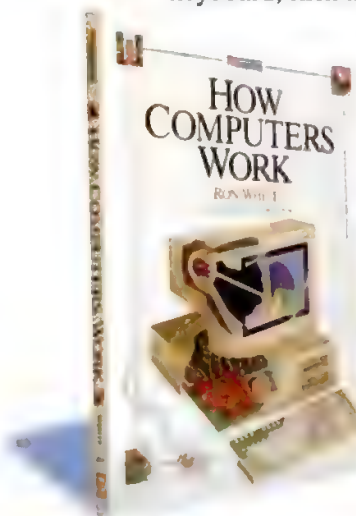
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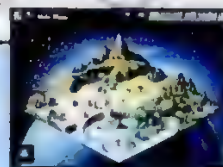


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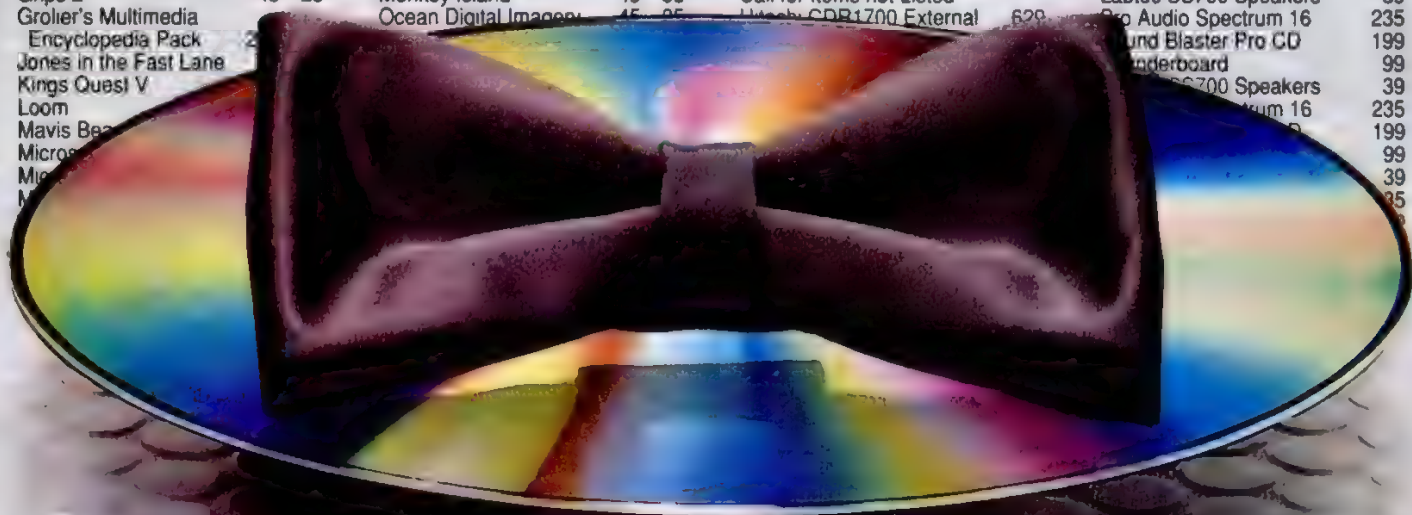
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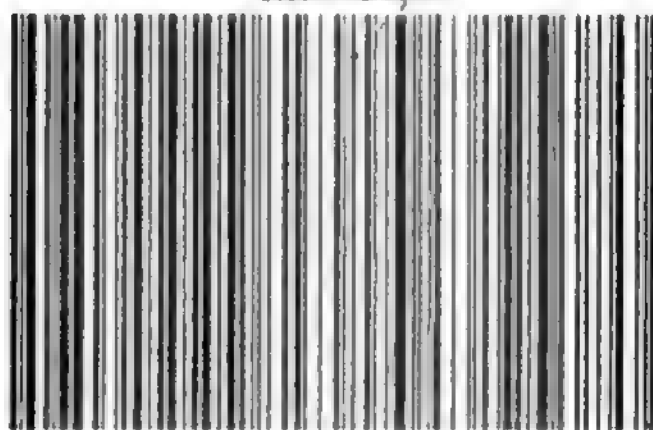
**Technical Support is a
toll-free call away!**



1. Follow instructions on the other side

Back

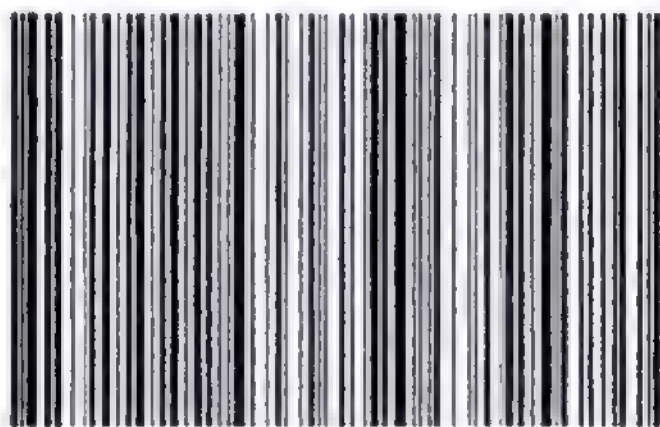
Gbs5ipBack-0028



Inverted Back

1. Follow instructions on the other side

Folded edge of the page



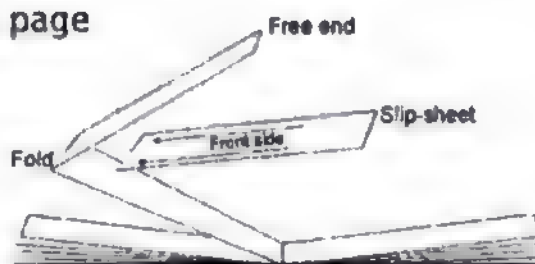
GbsSlipSheet-001

Inverted Foldout slip-sheet

Foldout slip-sheet



1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
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3. Slice the folded edge
4. Close the page and slip-sheet

COMPUTER SYSTEMS

Insight

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386sx-25MHz



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NBT1850K

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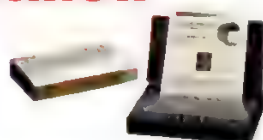
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Canon



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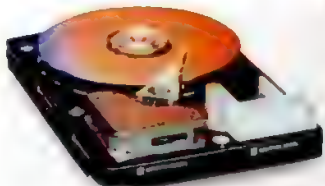
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8 Bit Kit		\$279	8 Bit Kit		\$349	8 Bit Kit		\$369
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16 Bit Kit	\$1,349

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16 Bit Kit	\$1,949

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Maxtor MX7213A, 15ms 3.5" 1"H	
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16 Bit Kit	\$419

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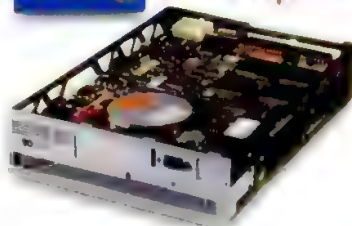
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				Winfax Pro			
				WordPerfect Office PC			
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				ARAGO Quicksilver 1.3			
				Clarion Personal Developer			
				Clipper			
				DataEase Express			
				DB Fast Windows			
				DBase IV			
				Family Tree Maker			
				FileMaker Pro Window			
				Foxbase Plus			
				Foxpro 2.0			
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				ARAGO Quicksilver 1.3			
				Clarion Personal Developer			
				Clipper			
				DataEase Express			
				DB Fast Windows			
				DBase IV			
				Family Tree Maker			
				FileMaker Pro Window			
				Foxbase Plus			
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				Fc.pro 2.0			
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				Procomm Plus Windows			
				Q-Modem			
				Remote 2 (Host & Caller)			
				Smartcom III			
				Smartterm 420 For Windows			
				Winfax Pro			
				WordPerfect Office PC			
				ARAGO DBXL 1.3			
				ARAGO Quicksilver 1.3			
				Clarion Personal Developer			
				Clipper			
				DataEase Express			
				DB Fast Windows			
				DBase IV			
				Family Tree Maker			
				FileMaker Pro Window			
				Foxbase Plus			
				Foxpro 2.0			
				Fc.pro 2.0			
				Foxpro 2.0			
				Instant			
				Nutsh			
				Pa			
				Novell Products			
				PC Anywhere 4.5			
				Host/Remote			
				Procomm Plus 2.0			
				Procomm Plus Windows			
				Q-Modem			
				Remote 2 (Host & Caller)			
				Smartcom III			
				Smartterm 420 For Windows			
				Winfax Pro			
				WordPerfect Office PC			
				ARAGO DBXL 1.3			
				ARAGO Quicksilver 1.3			
				Clarion Personal Developer			
				Clipper			
				DataEase Express			
				DB Fast Windows			
				DBase IV			
				Family Tree Maker			
				FileMaker Pro Window			
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				Remote 2 (Host & Caller)			
				Smartcom III			
				Smartterm 420 For Windows			
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				ARAGO DBXL 1.3			
				ARAGO Quicksilver 1.3			
				Clarion Personal Developer			
				Clipper			
				DataEase Express			
				DB Fast Windows			
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				Smartcom III	</		

Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

PCs

UPGRADING MOTHERBOARDS

❓ I have a 386SX/16 computer, but I'm thinking of replacing the motherboard so I can have a 386DX/33 or a 386DX/40. If I do, will it be any less powerful or reliable than a new 386DX system? Can I move my video board and IDE card over?

Lester Chase
Carol Stream, Illinois

► **PC MAGAZINE:** The motherboard upgrade route is certainly a reasonable way to go—especially if budget or space limitations prevent you from buying a new system. Be sure that the new CPU is included in the deal; many suppliers sell boards without CPU or memory, so the price you're quoted can be a lot less than you'll end up spending.

You also need to make sure that the memory components on your old system are compatible with the new motherboard. For example, you couldn't transfer DIP memory chips from your old board to your new one if it requires SIMMs.

Also check the memory speed requirements (measured in nanoseconds) of the new board and compare them with the rating of your existing memory. (This is usually indicated as a one- or two-digit number separated from the chip part number by a dash. For example, -7 or -70 indicates 70 ns chips.) You can always use faster-rated chips than specified, but never use slower ones. Contrary to popular belief, a faster-than-required memory chip won't improve performance. The chip speed rating only indicates that it will perform reliably up to that speed.

As for your expansion cards, you should have no problem moving them from a 386SX to a 386DX system. Since you'll be relying on the 16-bit ISA bus connection in either case, the difference in performance will be restricted to the differences in CPU. The only way you might lose out is if you decide to go with

Our Advisors

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a 486-based motherboard that offers one or more local bus expansion slots, such as one that is compatible with the new VL-Bus specification. You can get significant performance improvement using hard disk controllers and video adapters designed for local bus connections, so you might want to consider getting some new cards when you purchase the motherboard.

The rest of your existing components

—such as floppy and hard disks—should work fine with the new motherboard. The faster CPU should provide some improved performance for these as well. Keep in mind, however, that all components are continually being improved, so while the older components may work, you might get even better performance with newer ones.

Before you make your final decision, do consider a total replacement. Complete systems cost more, but not a lot more, than a motherboard with CPU and memory installed. It may be worthwhile to spend a few hundred dollars, since all the components will be new and possibly better-matched for optimal performance.—*Alfred Poor*

Peripherals

PRINTING MORE LINES ON LASERJETS

❓ I have been having some trouble getting an HP LaserJet-compatible printer to print correctly on a preprinted form that has 60 or more lines. It prints the first line on the second line of the form. The printer's manual says that it can only print 60 lines on an 8.5- by 11-inch sheet. Do you know of any way around this sort of limitation?

Randall Newton
Fife, Washington

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► **PC MAGAZINE:** Most laser printers do print only 60 lines per letter-size page, but there are a few things you can do to get around this: Change the default top and bottom margins, trick the printer into thinking it's printing on legal sheets, or change the vertical line spacing.

The standard type spacing (using 10-pitch Courier) is six lines per inch. Thus, if a sheet is 11 inches long, you should be able to fit 66 lines on a page. But, due to an unprintable region on all four sides of the paper, most laser printers can't print to the very edge of the page. This unprintable region may vary, but it's usually about a quarter of an inch from each edge and is a result of the way the printer's paper-handling mechanism is designed.

In addition, most laser printers add another quarter of an inch to this unprintable region for use as a margin. Therefore, laser printers usually have a default of a half inch margin at the top and bottom of a page. This means that the printer will skip three lines before starting to print at the top of the page, and then advance to the next page when it gets within three lines of the bottom of the sheet, leaving only 60 lines for printing. This is different from dot matrix printers, which let you start printing at the very top of the page.

You may be able to fit more lines on a page by changing the top margin setting to 0 lines (from the default of 3 lines). To do this, put the command

```
<Esc>&10E<Esc>*p0x0Y
```

in a text file. (To create the Escape character in a text file using DOS 5.0's editor, EDIT.COM, press Ctrl-P followed by the Esc key. In EDLIN, press Ctrl-V, []). Call the file TOPMARG.TXT and copy it to the printer using the command

```
COPY TOPMARG.TXT RN
```

You can even include this as part of a batch file that then calls your application. Keep in mind that this will only work if you don't need to leave any blank lines within the top quarter inch of the form.

Setting the top margin to 0 means that the first line sent to the printer—and part of the second line—will be in this unprintable region, and won't appear on the

page. So of the three-line default, you'll gain back one line on which you can print. If your program is simply sending carriage returns (as it would to advance the paper on a dot matrix printer) this should work out fine and your first printed line will appear a quarter inch from the top. If your program is sending 66 lines per page, however, they still will not all fit on one page. But to get more lines on a page, add

```
<Esc>&166F
```

to TOPMARG.TXT to define the page length as 66 lines. This gives you 66 lines, but you can't use all of them because the first two and the last one will fall in the unprintable regions. This unbalanced result is a function of how LaserJets handle lines of text that fall in the unprintable region; some "compatible" printers will print lines with the top or bottom of the letters missing, but a LaserJet won't print a line if any portion falls in the unprintable region.

If you need to print on the last line of the page, you can trick the printer into thinking that you are using legal-size paper. Add

```
<Esc>&13A
```

HOW TO CONTACT US

Do you have a hardware, software, or systems problem you can't solve? Do you have a tip you think other readers could use? Or maybe you'd like a better understanding of how something works. If so, we invite you to let us know about it. Our experts can give you practical solutions to your problems, provide techniques for using your software and hardware more productively, and help you grasp computer concepts and understand the latest technology.

It's easy to contact us. Just send us your submission (use ASCII format for text files) via the medium that's most convenient for you:

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MCI Mail: Solutions, 556-3896

CompuServe Mail: 72241,104

PC MagNet: Select Submissions to PC Magazine from the main PC MagNet menu. Upload your file to the most appropriate library. If at any time you need help, simply type a question mark (?) and hit Enter; a list of commands will be displayed. If you are not already a member of PC MagNet but would like to join, follow the instructions on page 12 to find your local access number.

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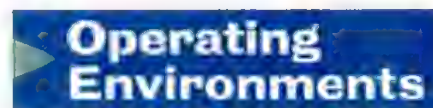
to the beginning of TOPMARG.TXT. When you attempt to print, the printer will report an error message, asking you to insert a legal-size piece of paper. Simply press the Continue button (on a LaserJet II), and the 66th line will print on your page.

Finally, some forms use nonstandard line spacing. Single-spaced Courier 10-pitch (12-point) type is designed for six lines per inch. If your forms are designed for more lines per inch, you'll need to change the setting for your printer. To change to eight lines per inch, for example, add the command

```
<Esc>&18D
```

to the end of TOPMARG.TXT.

—Alfred Poor



EASY ACCENTED CHARACTERS

TIP Has it ever happened that you have to type words like *bézier*, *français*, or *voilà*? Of course you can run Windows 3.1's new Character Map utility or some similar shareware program to search for

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Creating Accented Characters

Combination Characters	Accent Characters					
A	Á	Ä	À	Ã	Å	
C	Ç					
E	É	Ê	È		Ê	
I	Í	Î	Ì		Î	
N					Ñ	
O	Ó	Ô	Ò		Ô	
U	Ú	Û	Ù		Û	
Y	Ý					
a	á	ä	à		å	
c	ç					
e	é	ê	è		ê	
i	í	î	ì		î	
n					ñ	
o	ó	ô	ò		ô	
u	ú	û	ù		û	
y	ý					

Figure 1: Pressing an accent character followed by a supported combination character will yield an accented character when international support is enabled in Windows.

the specially accented characters, one at a time. Or, you can try to memorize the entire Windows symbol set. These solutions may work if you seldom need the special characters. But if you often need to type in a foreign language, you might prefer to take a much simpler approach that is already implemented in Windows, not just in Version 3.x, but in even earlier versions.

During setup, Windows prompts users to pick the language and keyboard layout. Instead of using the default English (American) setting for language and US for keyboard layout, choose English (International) and US-International, respectively. If you've already installed Windows, you can change the settings in the International dialog box in the Control Panel.

Now all you have to do is to change your typing habits. If you want to type Ä, simply type the quotation mark and then the capital A. To type Ç, type the apostrophe and the capital C. To form foreign characters, combine any of the vowels or other valid combination letters (as shown in Figure 1) with one of the following: " ' ~ .

The way this keyboard layout works is that if, for instance, you type an apos-

trope, Windows waits for you to type one of the combination letters before displaying anything on the screen. If you type a vowel following the apostrophe, Windows displays the special character with the apostrophe as an accent. On the other hand, if you type a letter other than the valid combination letters, such as a space, Windows displays the apostrophe itself on the screen.

Using this keyboard layout may require a small period of adjustment, but if you need foreign characters often, it's well worth the time and effort. Windows also provides other keyboard layouts including French, German, and Spanish. Just remember: When you want to type real quotation marks or a real caret, follow with a press of the spacebar. Otherwise, the statement "He read *A Tale of Two Cities*" would become "He read Å *Tale of Two Cities*."

Bertrand B. Chiu
Austin Texas

► **PC MAGAZINE:** If you decide to experiment with international characters in Windows, be sure to have your original Windows floppy disks handy. When you change the international settings in Control Panel, Windows usually asks for one of the original disks.

With international support, three different things can happen after you type one of the five accent characters, depending on what character you type next. If you type a character that can be modified by the accent character, Windows inserts the appropriate accented character. If you press space, Windows inserts the accent character itself, but not the space. For any other character, Windows inserts the accent character and the character you typed.

Note that Windows assumes the font currently in use supports the standard Windows international characters, sometimes called the ANSI character set. This is *not* the same as the extended ASCII character set, though the latter also supports some international characters. If you use a font like Terminal, in which the characters match the extended ASCII set, the uppercase accented characters will be displayed as ASCII line-drawing characters and the lowercase accented characters will show as Greek and math symbols!—Neil J. Rubenking

Word Processing

FLUSH LEFT AND FLUSH RIGHT ON THE SAME LINE

► **TIP** Here's a simple technique that's easy to overlook: Suppose you want one piece of text in Word for Windows flush left and another piece on the same line flush right—as with an equation on the left side, say, and an equation number at the right. Choose Format Paragraph, set alignment to Left, and make sure all three indentation options are set to 0. Then choose the Tabs button, remove any defined tab stops (as opposed to the default tab stop settings), and insert one right-aligned tab stop at the appropriate distance from the left margin. For instance, using WinWord's default of 1.25-inch margins left and right with 8.5-inch paper, you'd set the right-aligned stop at 6 inches, the width of the text area. Then enter the text you want flush left in that paragraph and insert a tab. Any text you add after the tab will be flush right.

Allin Cottrell
Winston-Salem, North Carolina

► **PC MAGAZINE:** This is the sort of tip that seems obvious, except when you're trying to figure out how to do it. Although the specifics here apply only to WinWord, the basic concept will work for any word processor that offers a right-aligned tab. Simply format the paragraph so that it is left-aligned with the left margin of the surrounding text, then place a right-aligned tab at the right margin.

In some word processors, you'll have to remove or override default tab stops and then reset them later. WinWord and Word, however, make this trick even easier by automatically deactivating any default tabs between the left margin and the manually entered tab stop, and by letting you apply the tabs to selected paragraphs. As a result, you don't even have to remove the default tabs to make this work, and you don't have to worry about resetting the tabs. Before you set the tabs make sure there is at least one paragraph following, so that each new paragraph will have the same the formatting as the paragraphs preceding the left-and-right—

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aligned line. Then move the cursor out of the specially formatted paragraphs before continuing.

With WordPerfect for DOS or Windows, you can get the same effect using the Flush Right command. You insert this by hitting Alt-F6 in WordPerfect for DOS. In WordPerfect for Windows, if you're using the WPDOS51 keyboard file you also hit Alt-F6, but it's Alt-F7 if you're using the default WordPerfect for Windows keyboard; alternatively, you can choose Layout, Line, Flush Right from the menus.

As the help screens in WordPerfect 5.0 and 5.1 for DOS will reliably misinform you, Alt-F6 will let you align one or more lines of text flush against the right margin. In truth, the command will also let you make just part of a line flush right, because the Flush Right code it inserts only applies to text that comes after it on the same line. (If you've defined a block with Alt-F4 before hitting Alt-F6 WordPerfect will insert a Right Justification code, which will apply until the next justification code. If you haven't defined a block first, WordPerfect will insert a Flush Right code, which will apply only to the current line.) To type flush left and flush right text on the same line, then, simply type the text that you want flush left, enter the Flush Right code, and then type the text that you want flush right.

Note in passing that you can use the Center command the same way (inserted with Shift-F6 in WordPerfect for DOS or in WordPerfect for Windows using the WPDOS51 keyboard file; or with Shift-F7 in WordPerfect for Windows using the default keyboard or by choosing Layout, Line, Center). This lets you easily create a line with flush left, centered, and flush right text on the same line.

TOGGLING BETWEEN FULL AND SPLIT SCREENS

TIP WordPerfect will let you split its screen to see two document windows at once, but the feature takes several steps. Figure 2 shows a simple macro that will let you toggle between single and dual editing windows with a single keystroke.

Rogier Gruys
Kumasi, Ghana

►PC MAGAZINE: This helpful little macro is straightforward enough that there isn't much to say about it. However, note that if you have already split the screen before running the macro during any given session, the macro will not toggle the screen the first time you run it. It will work the second time and afterwards. Note also that the version of the macro in Figure 2 will not run in WordPerfect, Version 5.0, because it depends on the {VARIABLE} command and named variables. The variation I've offered in Figure 3 will work in both 5.0 and 5.1, but uses arbitrarily numbered variables instead of descriptive names. (Both macros can be downloaded from the Utilities/Tips Forum on PC MagNet archived as SPLIT.ZIP.)

As always with WordPerfect macros, you cannot enter the commands in curly brackets into the macro editing screen by typing them in. For commands in all caps, type Ctrl-PgUp, then pick the command off the pop-up list. For commands in upper- and lowercase that have no effect while in the macro editing screen, as with {Screen}, simply type the appropriate command key (Ctrl-F3, in this case). For commands that will affect the macro editing screen, such as [Enter], type Ctrl-V before typing the command keystroke.

Note finally that this macro assumes a 25-line screen, with 24 lines available for the editing screen. However, there are other modes available—as you can see in WordPerfect 5.1 if you type Shift-F1, then choose Display, then Text Screen Type, then highlight the appropriate text

SPLIT.WPM

Complete Listing

```
(DISPLAY OFF)
(;)Check-if-window-has-been-split-before.
Full-size-window=24-lines,-split-size=11-lines~
(IF EXISTS)Winsize~
(ELSE)
  (ASSIGN)Winsize~"Full"~
(END IF)
(;)If-the-window-isn't-already-split,-split-it
Otherwise,-unsplit-it.~
(IF) (VARIABLE)Winsize~="Full"~
  (Screen)w
  11(Enter)
  (ASSIGN)Winsize~"Split"~
(ELSE)
  (Screen)w
  24(Enter)
  (ASSIGN)Winsize~"Full"~
(END IF)
```



Figure 2: This macro toggles WordPerfect between a split screen showing both document windows, and a full screen showing only one document.

SPLIT2.WPM

Complete Listing

```
(DISPLAY OFF)
(;)Check-if-window-has-been-split-before.
Full-size-window=24-lines,-split-size=11-lines~
(IF EXISTS)1~
(ELSE)
  (ASSIGN)1~Full~
(END IF)
(;)If-the-window-isn't-already-split,-split-it
Otherwise,-unsplit-it.~
(IF) (VAR 1)~="Full"~
  (Screen)w
  11(Enter)
  (ASSIGN)1~Split~
(ELSE)
  (Screen)w
  24(Enter)
  (ASSIGN)1~Full~
(END IF)
```



Figure 3: So that it will work in WordPerfect 5.0, this version of the macro in Figure 2 substitutes nondescriptive variable names.

screen driver, and hit Enter. The IBM VGA and compatible selection, for example, gives choices of 25, 28, 43, and 50 lines. If you use a mode that doesn't use 25 lines per screen, or you use the WordPerfect pull-down menus, which take a line away from the editing area, you'll want to change the macro to accommodate the number of lines for both the full-size and split screen.—M. David Stone

Spreadsheets

ENHANCED LABEL ENTRY

TIP Inspired by Christopher Yiangou's brilliant macro that lets you type the first few letters of a label to enter a longer la-

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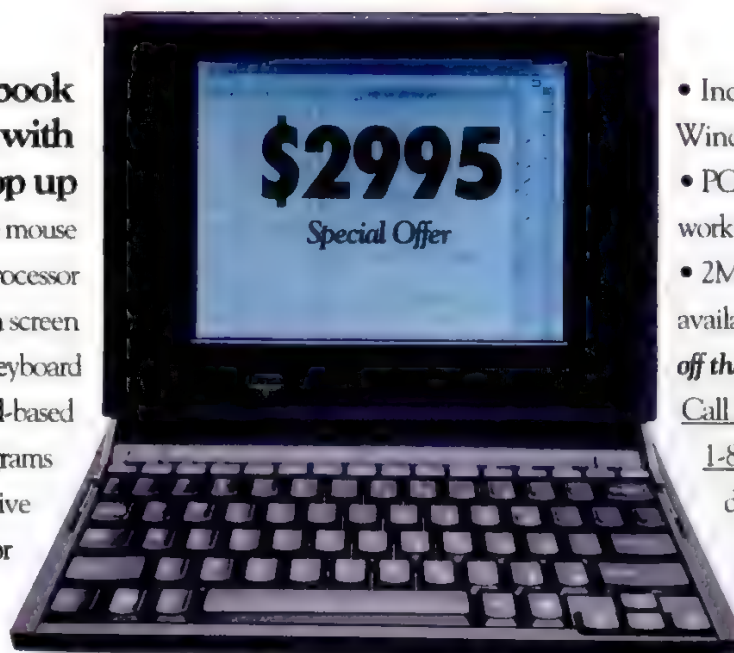
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CIRCLE 014 ON READER SERVICE CARD

ENLAB.WK1

	A	B	C	D	E	F	G	H	I
1	Macro to accept a substring of an item in a table								
2	and complete the entry								
3									
4	Based on a macro to accept left-substrings,								
5	by Christopher Yiangou (Braamfontein, Republic of South Africa)								
6	"Spreadsheets" column, PC Magazine, May 28, 1992, p.347-348.								
7	This modification, to accept any substring,								
8	is by Ralph Chapman, August 8, 1992.								
9									
10	KEY								
11	BUFF								
12	LOOKUP	@VLOOKUP(1,STABLE,1)							
13	PREFIX	@LOWER(@IF(\$BUFF<>"#AND#NOT#@ISERR(@FIND(\$BUFF,@UPPER(LOOKUP,0),@MID(LOOKUP,0,FIND(\$BUFF,@UPPER(LOOKUP,0)),"))							
14	SUBSTR	@UPPER(@IF(\$BUFF<>"#AND#NOT#@ISERR(@FIND(\$BUFF,@UPPER(LOOKUP,0)), \$BUFF,""))							
15	SUFFIX	@LOWER(@IF(\$BUFF<>"#AND#NOT#@ISERR(@FIND(\$BUFF,@UPPER(LOOKUP,0),@MID(LOOKUP,0,FIND(\$BUFF,@UPPER(LOOKUP,0))+@LENGTH(\$BUFF),100),"							
16	ENTRY	+PREFIX&SUBSTR&SUFFIX							
17									
18	↵	{LET BUFF,""}~							
19		+ENTRY~							
20	LOOP	{GET KEY}~							
21		{F KEY="{BACKSPACE}"}{REMOVE}							
22		{F KEY="{ESC}"}{RE~}{QUIT}							
23		{F KEY="{~}"}{COMMIT}							
24		{F @LENGTH(KEY)=1}{LET BUFF,BUFF&@UPPER(KEY)}~							
25		{F ENTRY="#AND#KEY<>"{BACKSPACE}"}{BEEP}{REMOVE}							
26		{BRANCH LOOP}							
27									
28	REMOVE	{F @LENGTH(BUFF)>=1}{LET BUFF,@LEFT(BUFF,@LENGTH(BUFF)-1)}~							
29									
30	COMMIT	{F ENTRY<>"}{RVLOOKUP~}{QUIT}							
31		{RE~}{QUIT}							
32									
33	TABLE	1 Bacon and Eggs 1 Omelette 1 Scrambled Eggs 1 Muesli 1 Toast and Jam 1 Rice Cereal 1 Croissant 1 Continental Breakfast 1 Boiled Eggs and Toast 1 Poached Eggs and Toast 1 Kippers with Poached Eggs 1 Haddock with Fried Eggs 1 Fried Eggs and Vienna Sausages							
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									

The formula in B33 is:
#NOT#@ISERR(@FIND(\$BUFF,@UPPER(C33,0))
--and is copied in cells B33..B45

The formula in B33 is:
#NOT#@ISERR(@FIND(\$BUFF,@UPPER(C33,0))
--and is copied in cells B33..B45

Figure 4: This Lotus 1-2-3 macro allows you to enter a label by typing any substring that occurs within the label.

ENLAB2.WK1

A B C D E F G H I J K

1 Macro to accept a substring of a label in a table
and go to the corresponding table entry

2

3

4 Based on a macro to accept left-substrings,
by Christopher Yiangou (Braamfontein, Republic of South Africa)
"Spreadsheets" column, PC Magazine, May 28, 1992, p.347-348;
and modification, to accept any substring,
by Ralph Chapman, August 8, 1992.
This modification, to go to the table entry,
is by Ralph Chapman, August 8, 1992.

10

11

12 KEY

13 BUFF

14 LOOKUP @VLOOKUP(1,STABLE,2)

15 PREFIX @LOWER(@IF(\$BUFF<>"#AND#NOT#@ISERR(@FIND(\$BUFF,@UPPER(LOOKUP,0),@MID(LOOKUP,0,FIND(\$BUFF,@UPPER(LOOKUP,0)),"))

16 SUBSTR @UPPER(@IF(\$BUFF<>"#AND#NOT#@ISERR(@FIND(\$BUFF,@UPPER(LOOKUP,0)), \$BUFF,""))

17 SUFFIX @LOWER(@IF(\$BUFF<>"#AND#NOT#@ISERR(@FIND(\$BUFF,@UPPER(LOOKUP,0),@MID(LOOKUP,0,FIND(\$BUFF,@UPPER(LOOKUP,0))+@LENGTH(\$BUFF),100),"

18 ENTRY +PREFIX&SUBSTR&SUFFIX

19

20 ↵ {LET GOTO,@CELLPONTER("ADDRESS")}

21 {LET BUFF,""}~

22 {GOTO}SCRATCH~

23 +ENTRY~

24 LOOP {GET KEY}~

25 {F KEY="{BACKSPACE}"}{REMOVE}

26 {F KEY="{ESC}"}{ABORT}

27 {F KEY="{~}"}{COMMIT}

28 {F @LENGTH(KEY)=1}{LET BUFF,BUFF&@UPPER(KEY)}~

29 {F ENTRY="#AND#KEY<>"{BACKSPACE}"}{BEEP}{REMOVE}

30 {BRANCH LOOP}

31

32 REMOVE {F @LENGTH(BUFF)>=1}{LET BUFF,@LEFT(BUFF,@LENGTH(BUFF)-1)}~

33

34 COMMIT {F ENTRY<>"}{LET GOTO,@LEFT(GOTO,@FIND("F,GOTO,1))&@TRING(@VLOOKUP(1,STABLE,1),0)}

35 ABORT {BLANK SCRATCH}

36 {GOTO}

37 GOTO \$E41

38 ~{QUIT}

39

40 SCRATCH

41 TABLE

		Cost	Minutes
0	41 Bacon and Eggs	\$2.50	15
0	42 Omelette	\$3.50	15
0	43 Scrambled Eggs	\$2.00	10
0	44 Muesli	\$1.75	5
0	45 Toast and Jam	\$1.50	5
0	46 Rice Cereal	\$1.50	1
0	47 Croissant	\$2.25	1
0	48 Continental Breakfast	\$2.00	1
0	49 Boiled Eggs and Toast	\$2.00	5
0	50 Poached Eggs and Toast	\$2.25	10
0	51 Kippers with Poached Eggs	\$3.00	15
0	52 Haddock with Fried Eggs	\$3.50	15
0	53 Fried Eggs and Vienna Sausages	\$3.25	15

The formula in B41 is:
#NOT#@ISERR(@FIND(\$BUFF,@UPPER(D41),0))
--and is copied in cells B42..B53

The formula in C41 is:
@CELL("ROW",D41)
--and is copied in cells C42..C53

The formula in B41 is:
#NOT#@ISERR(@FIND(\$BUFF,@UPPER(D41,0))
--and is copied in cells B42..B53

The formula in C41 is:
@CELL("ROW",D41)
--and is copied in cells C42..C53

Figure 5: This 1-2-3 macro adds to the macro in Figure 4 the feature of placing the cellpointer at a table entry corresponding to the label entered.

EDGE 486DX2 • 66



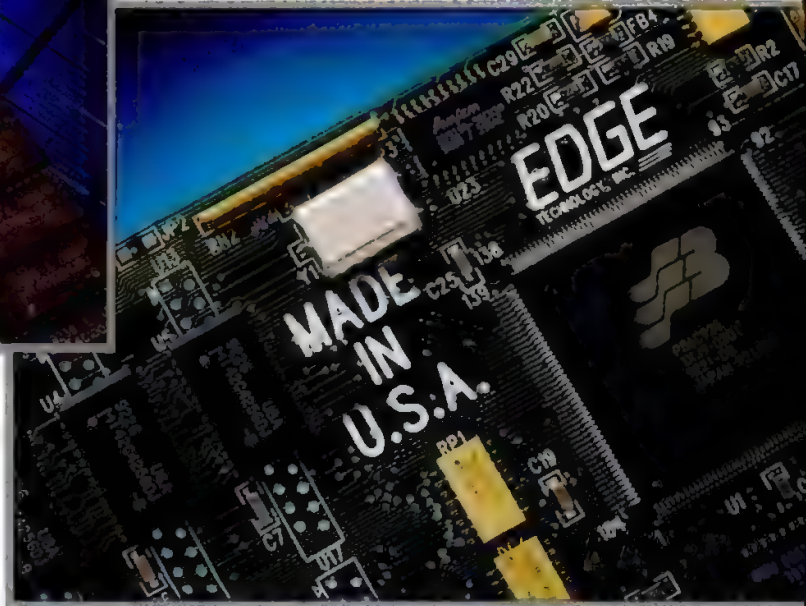
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CIRCLE 119 ON READER SERVICE CARD

SOLUTIONS
Spreadsheets

bel from a list (May 26, 1992), I adapted that macro to find a standard label given any substring within the list of labels. My extension of Mr. Yiangou's macro is listed in Figure 4.

The modification essentially replaces a test for left-substring (`BUFF=@LEFT(BUFF, . . .)`) with a search for substring (`@FIND(BUFF, . . .)`) in the formulas to the left of the column of standard labels, and converts the displayed entry to three parts: the substring as typed in (in uppercase), and the preceding and the following text of the first matching standard label (in lowercase). The `@FIND()` formulas had to be adjusted to convert to uppercase for searching, and to use `@ISERR()` to indicate whether the search string is present or not in each standard label. `@FIND` returns a number if it finds the search string, and `ERR` if it doesn't.

Now if you invoke the macro and type "TT", the macro displays "omeleTTe" (the first label that contains "TT"), with your substring in uppercase and the rest of the label in lowercase, by the means

described in the original article. (This assumes, of course, that you're using the same set of labels that Mr. Yiangou used.)

Intrigued by the additional possibilities for this technique, I made a further modification that causes the cellpointer to go to the table entry corresponding to the matching label. In an application I have, the labels are keys to a wider table of data, and what I want to do is go to the table row that contains the matching label.

To do this, the macro goes to a "scratch" (temporary or work) location at the top of the column of labels, after recording the present location of the cellpointer, and uses that particular cell to display the label selected by the substring typed in (so as to avoid disturbing the contents of the table, where the cellpointer was presumably located when the macro was invoked). The macro puts into the scratch cell a reference to the `ENTRY` cell, as in the original version of the macro.

The user then types a substring, and

the selected label is displayed in the scratch location, with the specified substring appearing in uppercase and the rest of the string in lowercase, as I described earlier.

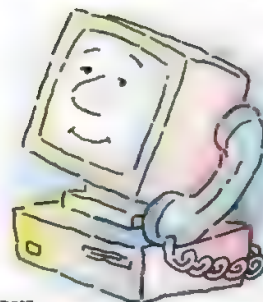
When the user confirms the selection by pressing Enter, the macro constructs the address to go to by taking the column portion of the location recorded at the beginning, and by concatenating the row number given in a column next to the labels in the table.

This places the cellpointer in the row containing the selected label, and in the same column it was in when the macro was invoked. The listing shows two columns of data placed next to the breakfast menu labels. The idea is that the user may be working within one of these columns of data and may want the macro to jump to locations within that same column.

If the user backs out or escapes from the macro, the cellpointer is sent back to the location recorded at the beginning of the macro execution. Figure 5 shows this additional modification of Mr. Yiangou's original idea.

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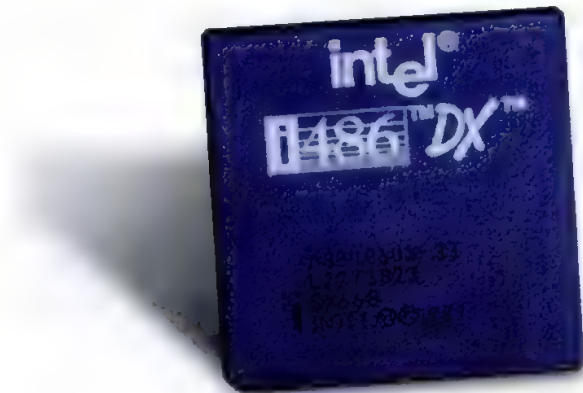
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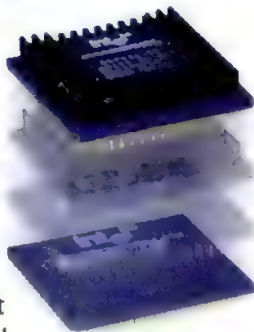
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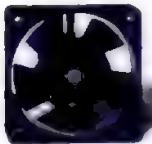
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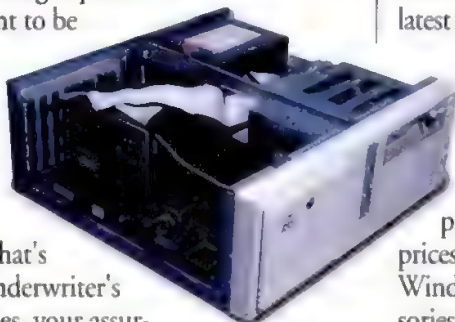
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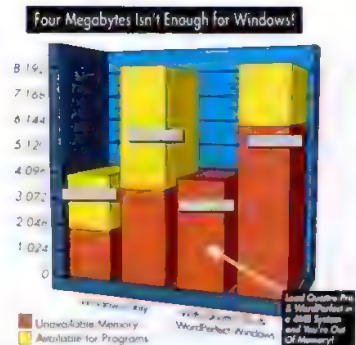
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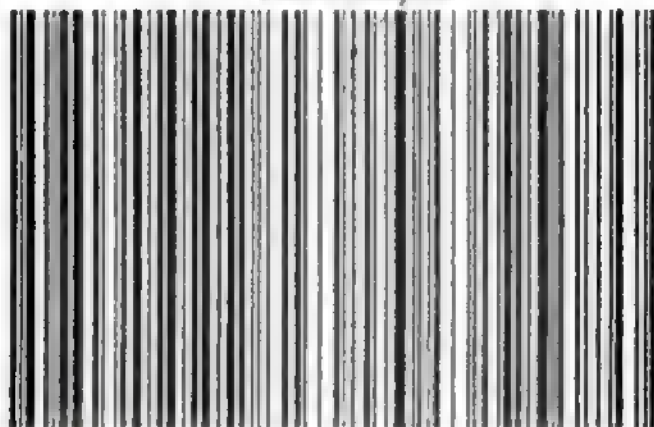
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Back

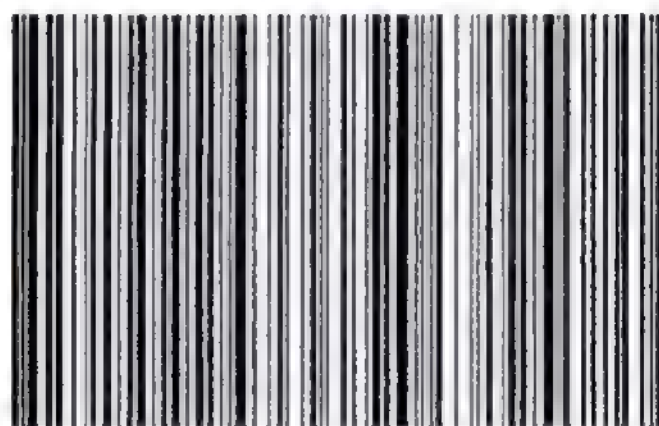
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Inverted Back

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Folded edge of the page



GbsSlipSheet-001

Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page

2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



1. Open the foldout page

2. Insert this sheet with

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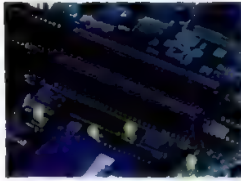
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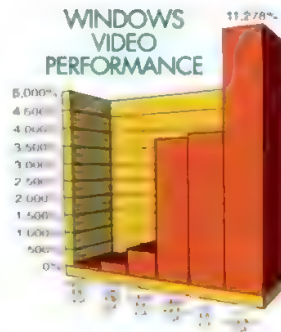
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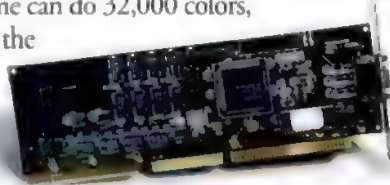
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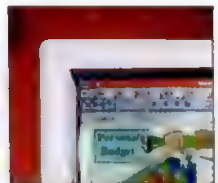
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WordPerfect is the #1 selling word processing software and the Windows version is loaded with features. It includes the ability to create & edit tables, equations, lists and graphics.

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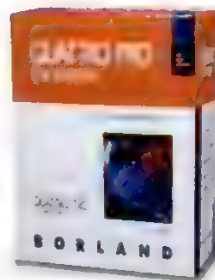


Quattro Pro for Windows

"Quattro Pro for Windows is worth the wait" proclaims PC Magazine. QPW uses spreadsheet notebooks to easily organize your spreadsheets. Click your right mouse button and Object Inspectors lets you change attributes instantly! Speedbars give you those one-click shortcuts that

change depending on what you're working on! Interface Builder lets you build applications without programming. "QPW comes with a separate

Database Desktop application - a beautifully designed query-by-example tool" says PC Magazine, "QPW's graphs are gorgeous and include rotatable 3-D types as well as options to adorn them." Need we add more?



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Paradox is the most advanced relational database ever created for the PC. Now it's the fastest. For first time users or application developers, Paradox provides the ease of use and power you need! New

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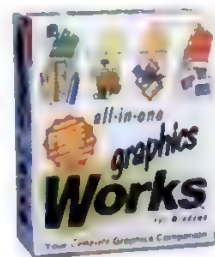


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With five applications in one, Graphics Works from Micrografx gives you complete graphic tools for Windows.

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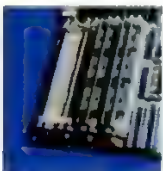


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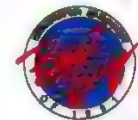
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(You can download both macros from the Utilities\Tips Forum on PC MagNet archived as ENLAB.ZIP.)

*Ralph S. Chapman
Naperville, Illinois*

► **PC MAGAZINE:** Like Mr. Yiangou's macro, these two macros can do a great deal to simplify the entry of labels from standard lists. More important than saving keystrokes, they can practically eliminate typing errors. Mr. Chapman's extensions are particularly useful in situations where the user may not know exactly how the standard labels are spelled. Does that menu item read "Haddock with Fried Eggs" or "Fried Eggs with Haddock"? If you're not sure, just call the macro and type DD.

When entering the first macro manually, name the following ranges:

```

BUFF B11..B11  COMM B30..B30
ENTR B16..B16  KEY  B10..B10
LOOK B12..B12  LOOP B20..B20
PREF B13..B13  REMO B28..B28
SUBS B14..B14  SUFF B15..B15
TABL B33..C45
\L B18..B18

```

And for ENLAB2.WK1 use these names:

```

ABORT B35..B35  BUFF B13..B13
COMMIT B34..B34  ENTRY B18..B18
GOTO  B37..B37  KEY  B12..B12
LOOKUP B14..B14  LOOP B24..B24
PREFIX B15..B15  REMOVE B32..B32
SCRATCH D40..D40
SUBSTR B16..B16
SUFFIX B17..B17
TABLE  B41..D53
\L      B20..B20

```

For a look at the magic behind these macros, see "Standard Labels" in the May 26, 1992, column.—*Craig Stinson*

Databases

CONVERT NUMBERS TO WORDS IN FOXPRO

✓ **TIP** Have you ever needed to convert a number to words? For example, from \$99.99 to "Ninety-Nine Dollars and Ninety-Nine Cents"? The program

shown in Figure 6 does just that. It has several distinguishing characteristics—for one, it's faster than other methods. It can accept parameters passed by value or by reference. It optionally returns the currency in American, British, or Nigerian words. And it returns words for any number up to 999 trillion.

Here's how it works: First, it checks to make sure that the correct variables are passed in the appropriate format. Then it assigns default values to missing variables (parameters that were not passed).

Next, it parses the number to be translated and places the values in an array, least significant digit first. So the number 2,892,106 is placed in array like this:

```

[7] [6] [5] [4] [3] [2] [1]

  2   8   9   2   1   0   6

```

The final computation is done in three steps. First, the program assigns words to numbers according to their position within the array. For example, the first, fourth, and seventh values in the array shown above belong in the units category. The second and fifth values belong in the tens category. The third and sixth belong in the hundreds category. This is called *positional grouping*.

Then words are added, based on each number's sequential position in the array. For example, "Hundred" is added to a number in the hundreds position, "Thousand" for a number in the thousands position, and so on. The resulting groups are placed in the array named Class.

The final step is to take the groups from the Class array in reverse order—trillions, billions, millions, thousands, hundreds—and then add the cents and the currency values if requested.

You pass N2W the number to convert and an indication of the currency type. The currency type can be expressed as either \$ or USA for dollars and cents, £ or GRB for British pounds and pence, and N or NGR for Nigerian currency. The default currency is the dollar.

*Bajo Osunsanya
Ft. Lauderdale, Florida*

► **PC MAGAZINE:** This can be useful for printing checks or otherwise representing numeric data in English-language for-

mat. To give the function a try, enter the following commands in the FoxPro Command window:

```

SET PROC TO N2W
? N2W(123.56)

```

FoxPro responds with

```

One Hundred Twenty-Three
Dollars and Fifty-Six Cents

```

The N2W function converts a number into words. If you leave out the second parameter entirely, as in my example, the function defaults to dollars and cents. To specify either the British or Nigerian currency type, you must include the second parameter. For example, to specify British currency, try this:

```
? N2W(123.56, 'GRB')
```

and you'll get

```

One Hundred Twenty-Three Pounds
and Fifty-Six Pence

```

The 'GRB' means use the British currency. Similarly, you can substitute 'NGR' for Nigerian currency.

Note that N2W can be used for non-currency numeric data too. For example, to convert a number to English words without including a currency (the "Dollars" and "Cents"), try

```
? N2W(123, 'NUM')
```

which will produce

```
One Hundred Twenty-Three
```

The 'NUM' tells the function to skip the currency. You could use this for representing a quantity.

I made several changes to Mr. Osunsanya's code. In the original, a value of zero returned a null string; that is, N2W(0.00) returned a null string. I altered the code so that it converts 0 to Zero instead. For example,

```
? N2W(0.00)
```

yields

```
Zero Dollars and Zero Cents
```


The original N2W did not indicate a negative number as being negative. For example, N2W(-1) returned "One Dollar." If you use the function mainly for printing checks, it's reasonable to assume you'll never need to pass it a negative number. But you might have a need sometime to convert a non-currency number to English, such as -1.10. So I added support for the word "Minus." For example:

```
? N2W(-1.10, 'NUM')
```

gives you

Minus One Point Ten

By default, N2W prints the decimal portion of any amount as *n* Cents. For instance, .20 is converted into "Twenty Cents." For printing checks, an alternate format that represents the cents portion as a number over 100 is sometimes preferred, so I changed the code to use this alternative format if you pass a third parameter to the function. Any third parameter will do—it's the presence (as opposed to the absence) of a third parameter that kicks in this format. For example, the following line

```
? N2W(123.56, '$', 1)
```

produces

One Hundred Twenty-Three
Dollars and 56/100

The third parameter gives you the "56/100." Without the third parameter it would be "Fifty-Six Cents."

Finally, the original code lets you pass an ASCII numeric value for the currency type parameter, as an alternative to the character options. For example, you could have used 36 for '\$'. To trim the

Foxpro Numbers to Words Program

1 of 2

```
*****
* N2W.PRG                                FoxPro 2.0
*****
PARAMETER nVar, cCurrency, lChecktype
IF PARAMETER() = 0 OR !TYPE("nVar")="N"
    RETURN "Not a valid request!"
ENDIF
IF PARAMETER() = 1 OR TYPE("cCurrency")<>"C"
    cCurrency="$"
ENDIF
IF PARAMETERS() > 2
    lCheckType = .T.
    && Presence of third parm means
    && use the 00/100 form for cents
ENDIF
nstr = ALLTRIM(STR(nVar,20,2))
nlen = LEN(nstr)
noclass = CEILING(nlen/3)
nlen=noclass * 3
nstr=PADL(nstr,nlen)
num2word = ""
DIMENSION nword[nlen], nvalue[nlen]
FOR i = 1 TO nlen STEP 1
    && Fill up the arrays with values
    nvalue(i) = SUBSTR(nstr,nlen - i + 1, 1)
    nword(i) = ""
ENDFOR
* STEP 1, parse each number according to its position
* <positional grouping analysis>
*
FOR nbit = 1 TO nlen STEP 1
    checkbit = RIGHT("00"+LTRIM(STR(nbit)),2)
    DO CASE
        CASE INLIST(checkbit, '01', '04', '07', '10', '13', '16')
            DO unitshunds
        CASE INLIST(checkbit, '02', '05', '08', '11', '14', '17')
            DO tens
        CASE INLIST(checkbit, '03', '06', '09', '12', '15', '18')
            DO unitshunds
        ENDCASE
    ENDFOR
* STEP 2, parse each number according to its sequence
* and group accordingly <sequential grouping analysis>
*
DIMENSION class[noclass]
FOR i = 1 TO noclass
    STORE "" TO class(i)
ENDFOR
FOR i = 2 TO noclass
    IF !EMPTY(nword(3*i))
        class(i) = nword(3*i) + " Hundred"
    ENDIF
    class(i) = ALLTRIM(class(i)) + ;
    IIF(!ALLTRIM(nword(3*i-1))="", " " + ALLTRIM(nword(3*i-1)) + ;
    ALLTRIM(nword(3*i-1))
    IF !nvalue(3*i-1)="1"
        DO CASE
            CASE !ALLTRIM(nword(3*i-1))="" AND !ALLTRIM(nvalue(3*i-2))=""
                class(i) = ALLTRIM(class(i)) + "-" + ALLTRIM(nword(3*i-2))
            CASE ALLTRIM(nword(3*i-1))="" AND !ALLTRIM(nvalue(3*i-2))=""
                class(i) = ALLTRIM(class(i)) + " " + ALLTRIM(nword(3*i-2))
            ENDCASE
        ENDIF
    class(i) = ALLTRIM(class(i))
DO CASE
CASE i = 6
    class(i) = IIF(!EMPTY(class(i)), class(i) + " Trillion", "")
CASE i = 5
    class(i) = IIF(!EMPTY(class(i)), class(i) + " Billion", "")
CASE i = 4
```

```

    class(i) = IIF(!EMPTY(class(i)), class(i) + " Million", "")
CASE i = 3
    class(i) = IIF(!EMPTY(class(i)), class(i) + " Thousand", "")
ENDCASE
num2word = class(i) + num2word
ENDFOR
IF RIGHT(ALLTRIM(num2word),1)=", "
    num2word = LEFT(ALLTRIM(num2word), LEN(ALLTRIM(num2word))-1)
ENDIF
dec2word = nword(2)
IF !nvalue(2)="1"
    dec2word = dec2word + ;
    IIF(!ALLTRIM(nword(2))="" AND !ALLTRIM(nvalue(1))="" AND !nvalue(1)="", "-") + ;
    nword(1)
ENDIF
dec2word = ALLTRIM(dec2word)
nat_bcurr = ""
nat_scurr = ""
num2word = IIF(ALLTRIM(num2word)="", "Zero", num2word)
dec2word = IIF(ALLTRIM(dec2word)="", "Zero", dec2word)
num2word = IIF(nVar < 0, "Minus " + num2word, num2word)
IF UPPER(cCurrency)="" NUM
    RETURN IIF(dec2word="" "Zero", num2word, num2word + " Point " + dec2word)
ENDIF
* STEP 3, add currency if requested
*
DO curr2word
num2word = num2word + " " + nat_bcurr
dec2word = dec2word + " " + nat_scurr
IF lCheckType
    && SR -- Use 99/100 check format
    dec2word = ALLTRIM(NVALUE(2)) + ALLTRIM(NVALUE(1)) + "/100"
ENDIF
RETURN num2word + IIF(!ALLTRIM(dec2word)="" AND !dec2word, " and " + dec2word)
PROCEDURE unitshunds
DO CASE
CASE nvalue(nbit) = '1'
    nword(nbit) = 'One'
CASE nvalue(nbit) = '2'
    nword(nbit) = 'Two'
CASE nvalue(nbit) = '3'
    nword(nbit) = 'Three'
CASE nvalue(nbit) = '4'
    nword(nbit) = 'Four'
CASE nvalue(nbit) = '5'
    nword(nbit) = 'Five'
CASE nvalue(nbit) = '6'
    nword(nbit) = 'Six'
CASE nvalue(nbit) = '7'
    nword(nbit) = 'Seven'
CASE nvalue(nbit) = '8'
    nword(nbit) = 'Eight'
CASE nvalue(nbit) = '9'
    nword(nbit) = 'Nine'
ENDCASE
RETURN
PROCEDURE tens
DO CASE
CASE nvalue(nbit) = '1'
    DO CASE
        CASE nvalue(nbit-1) = '0'
            nword(nbit) = 'Ten'
        CASE nvalue(nbit-1) = '1'
            nword(nbit) = 'Eleven'
        CASE nvalue(nbit-1) = '2'
            nword(nbit) = 'Twelve'
        CASE nvalue(nbit-1) = '3'
            nword(nbit) = 'Thirteen'
```

Figure 6: The N2W function returns the English-language version of a number. Pass it the parameter 123 and it returns "One Hundred Twenty-Three."



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RAM	4MB (expandable to 32MB)		
Cache	128KB		
Monitor	14" N-I 72Hz HRVGA		
Video	Local bus video		
Diskette size	Dual floppy drive		
Chassis	Low profile (Full profile available)		
Software	FREE Windows 3.1		
	FREE MS DOS 5.0		
	FREE Close-up 4.0		
FREE serial mouse	✓		
Shipping within 3 days	✓		
30-day money-back guarantee	✓		
30-day exchange policy	✓		
1-year limited warranty	✓		
Factory repairs within 3 days	✓		
Toll-free technical support	✓		
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- 64 levels of grayscale
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- 120MB IDE hard drive
- 1.44MB 3.5" internal floppy drive
- 4MB RAM expandable to 20MB
- Built-in mouse trackball
- Serial and parallel ports, PS/2 keyboard connectors; external VGA video for simultaneous display
- Only 6.3 pounds including battery
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- Dual floppy drive
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- Local bus video
- Dual floppy drive
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- 14" non-interlaced 72Hz flicker-free HRVGA. (1MB memory for 1024x768 with 256 colors)
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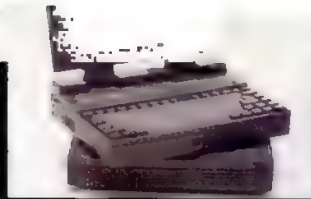
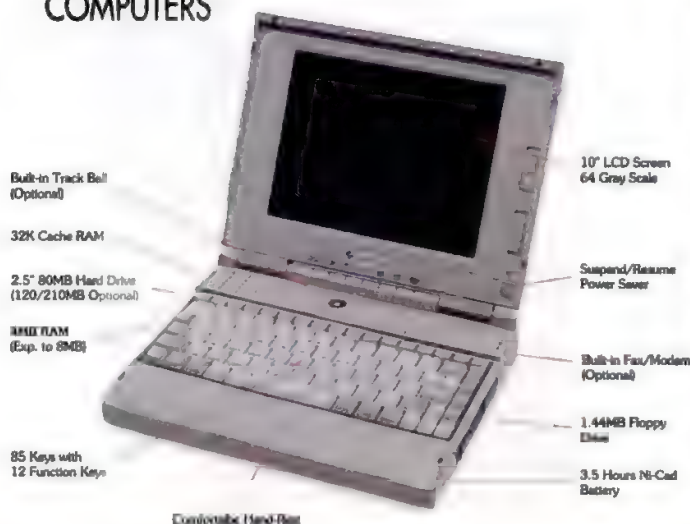
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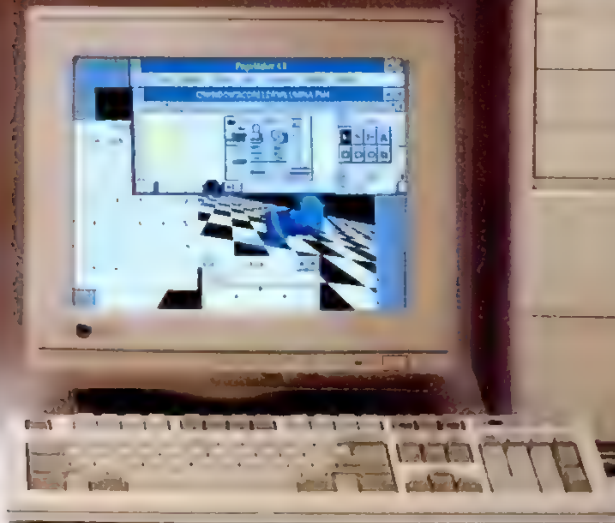
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Foxpro Numbers to Words Program

2 of 2

```
CASE nvalue(nbit-1) = '4'
  nword(nbit) = 'Fourteen'
CASE nvalue(nbit-1) = '5'
  nword(nbit) = 'Fifteen'
CASE nvalue(nbit-1) = '6'
  nword(nbit) = 'Sixteen'
CASE nvalue(nbit-1) = '7'
  nword(nbit) = 'Seventeen'
CASE nvalue(nbit-1) = '8'
  nword(nbit) = 'Eighteen'
CASE nvalue(nbit-1) = '9'
  nword(nbit) = 'Nineteen'
ENDCASE
CASE nvalue(nbit) = '2'
  nword(nbit) = 'Twenty'
CASE nvalue(nbit) = '3'
  nword(nbit) = 'Thirty'
CASE nvalue(nbit) = '4'
  nword(nbit) = 'Forty'
CASE nvalue(nbit) = '5'
  nword(nbit) = 'Fifty'
CASE nvalue(nbit) = '6'
  nword(nbit) = 'Sixty'
CASE nvalue(nbit) = '7'
  nword(nbit) = 'Seventy'
CASE nvalue(nbit) = '8'
  nword(nbit) = 'Eighty'
CASE nvalue(nbit) = '9'
```

```
  nword(nbit) = 'Ninety'
ENDCASE
RETURN
PROCEDURE curr2word
STORE .T. TO s_breq, s_sreq
DO CASE
CASE (cCurrency) = '$' OR 'USA' $ UPPER(cCurrency)
  nat_bcurr = 'Dollar'
  nat_scurr = 'Cent'
CASE (cCurrency) = '£' OR 'GRB' $ UPPER(cCurrency)
  nat_bcurr = 'Pound'
  nat_scurr = 'Pence'
  s_sreq = .F.
CASE (cCurrency) == 'N' OR 'NGR' $ UPPER(cCurrency)
  nat_bcurr = 'Naira'
  nat_scurr = 'Kobo'
  STORE .F. TO s_breq, s_sreq
OTHERWISE
  nat_bcurr = 'Dollar'
  nat_scurr = 'Cent'
ENDCASE
nat_bcurr = IIF(ALLTRIM(num2word) == '', ;
  IIF(nvalue(4)='1' AND num2word=='One', nat_bcurr, nat_bcurr+;
  IIF(s_breq, 's', '')), '')
nat_scurr = IIF(ALLTRIM(dec2word) == '', ;
  IIF(nvalue(1)='1' AND dec2word=='One', nat_scurr, nat_scurr+;
  IIF(s_sreq, 's', '')), '')
RETURN .T.
```

code for publishing I removed this support, since it was redundant.

The N2W function can be downloaded from PC MagNet. Look for N2W.ZIP in the Databases section.

—Sal Ricciardi

Graphics

ARTFUL IMAGES WITH PAGEMAKER

❷ The sample designs in books and magazines about desktop publishing often contain fancy effects such as tinted photographs and type overlaid on faint pictures. Do I have to buy a special program to create effects such as these or can I produce them with PageMaker, which I already use?

*Pamela Miller
Austin, Texas*

► **PC MAGAZINE:** PageMaker's image control functions are intended primarily as production tools—for example, you can improve the quality of a photograph by boosting the grayscale picture's contrast, in order to keep the highlight areas pure white. But you can use these same features to produce a host of special effects including posterized and negative images, as Figure 7 illustrates. Note, however, that to apply the full range of PageMaker's image enhancement tools, you

must start with a bitmapped *grayscale* picture in either the .BMP, .TIF, or .PCX format. PageMaker's internal functions can't alter a color file.

Let's start with one of the effects you mentioned: *surprinting* (the professional printer's term for overprinting) type on a light photograph. You'll need the functions found in PageMaker's Image Control dialog box to carry out this particular process.

Select the picture to modify, then open the Image Control dialog found on the Element menu. Increase the Lightness setting until the picture's black values turn gray. You can also decrease the Contrast setting in order to compress the range of tonal values so that both black and white values move toward gray.

The Image Control dialog makes it easy to experiment with the Lightness and Contrast settings—either by entering values into the associated text boxes or by moving the slider bars. Use the Apply button to preview the effects of your changes without closing the dialog box. If you like what you see, click OK to accept the changes. Otherwise, continue adjusting the Lightness and Contrast settings. At any point, the Default button returns the picture to its original condition.

Your letter also mentioned tinted photographs. Look again

at Figure 7, which shows that PageMaker can colorize grayscale images: The sample is color on one half and grayscale on the other.

To accomplish this effect, overlay two copies of the same picture using PageMaker 4.0's power-paste shortcut (Control-Shift-P), which pastes the object stored in the clipboard onto exactly the position from which it was copied. This assures that the pictures align perfectly. Now use the cropping tool to hide half of the topmost picture. To assign the bitmapped grayscale image a color, simply click on a color that is defined in the Color palette.

When you change the color of an imported picture, PageMaker can display the colorized version on-screen and output the tinted image to a color printer. It can even generate a 2-color separation

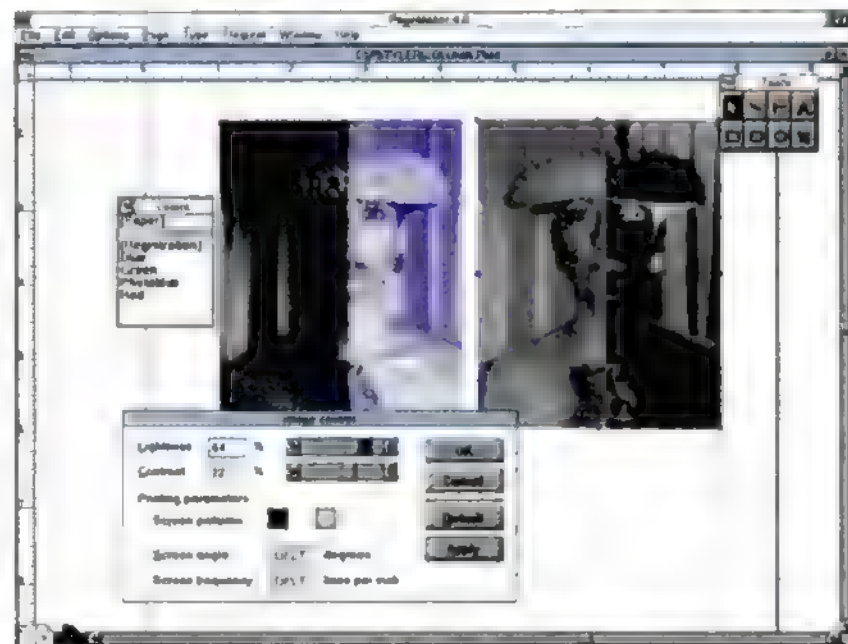


Figure 7: This shows some of the special effects, such as colorizing a grayscale image, that you can produce with PageMaker.

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52M



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28M

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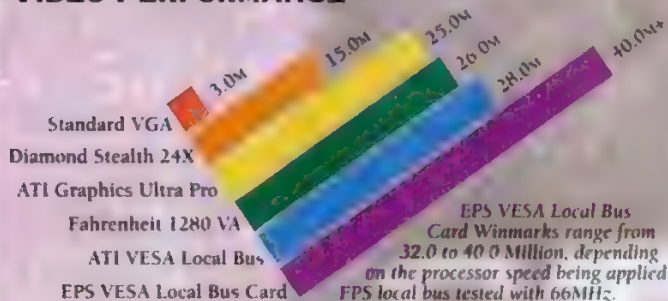
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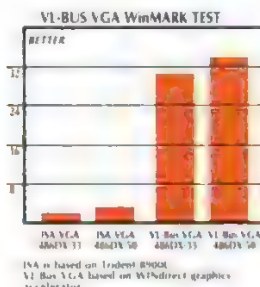
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INFO WORLD

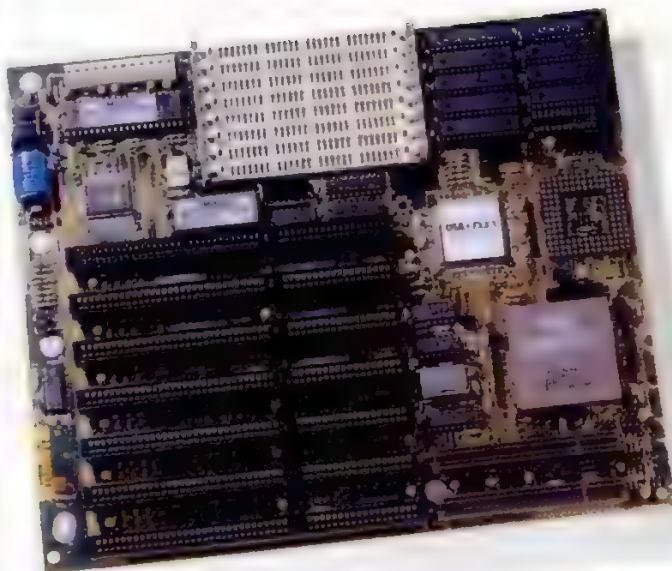
October 1992
In a head-to-head test of a dozen leading 486 machines, "the Keydata 486/33 WindowStation posted the highest SYSmark 92 rate" was singled out for Keydata's "first-rate support policies," and was awarded the Infoworld "Buyers Assurance Seal".



August 1992
"The Keydata 486/33 WindowStation offers a lot of computing for its price ... If you really want to exploit Windows, a system like this one is a really good place to start."

COMPUTER SHOPPER

November 1992
"Keydata's 486/33 WindowStation contained perhaps the best combination of parts, price, performance and service," and was selected for "The Winners Circle".



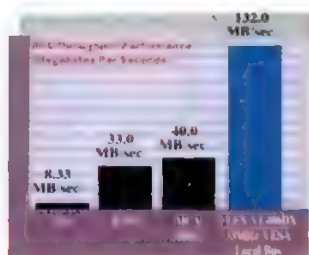
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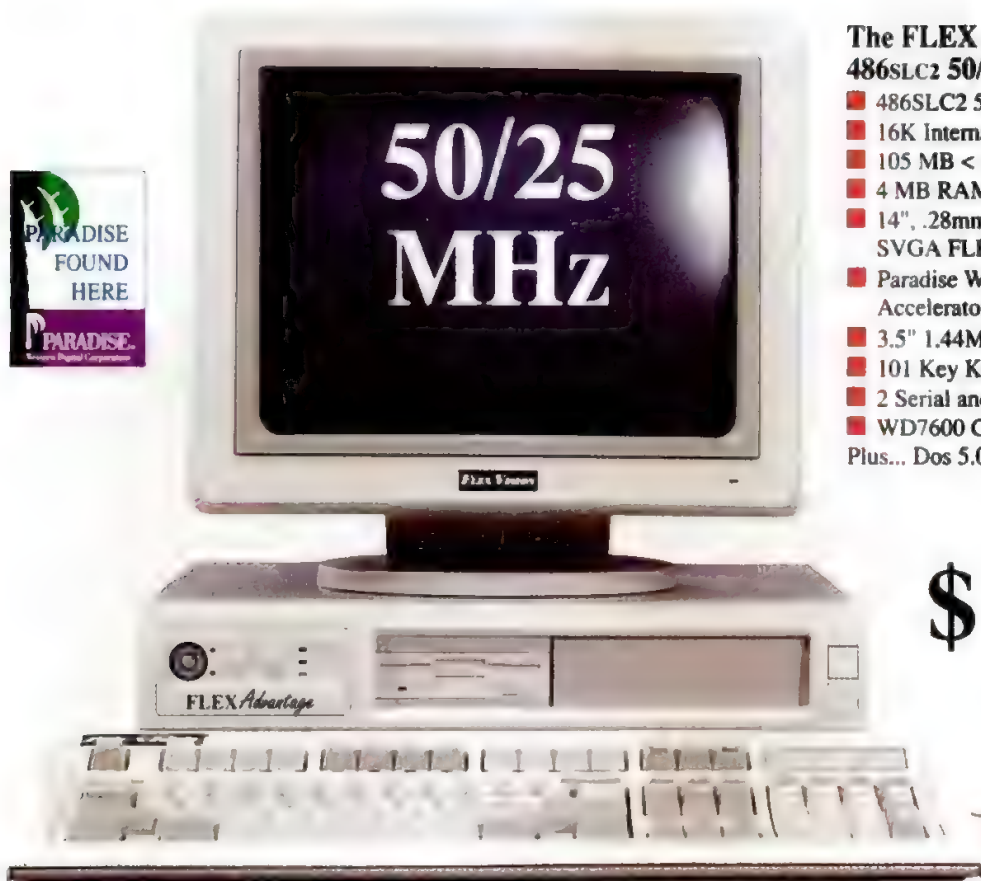
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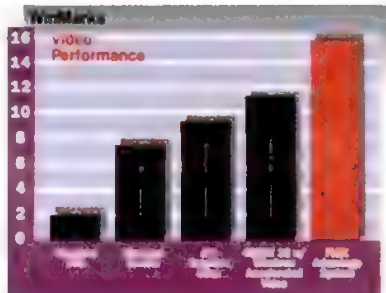
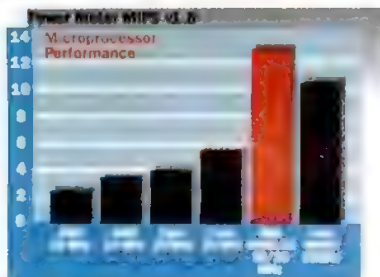
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(in the commercial printing business a 2-color separation is also known as a mechanical separation because an element, either text or a picture, is printed in color by physically cutting it from the black printing plate and then placing it on the color printing plate). If, however, you use a third-party program such as Inset Systems' HiJaak Color Sep or Publisher's Prism from InSight Systems to produce the separation, you'll get exactly the information stored in the file—in other words, grayscale rather than color.

Several important factors argue for using a full-blown image editor (such as Aldus PhotoStyler, Micrografx's Picture Publisher or ZSoft's PhotoFinish) instead of PageMaker. For one, PageMaker's enhancement tools apply to an entire image—they affect it globally, in other words. This means that you can't use it to edit only a portion of an image. For example, no tool exists that can remove a background in order to create a silhouetted effect.

Similarly, PageMaker can't change the actual RGB values of the pixels in a digitized photograph, so if you colorize a picture in your document, you can print the results only as a composite proof on a color laser printer or as a true 2-color mechanical separation. To produce the image as part of a 4-color separation, you must first use an image-editing or paint program to convert the grayscale data to color information.

More important, image-editing programs create files that are more space-efficient. In the sample document shown here, for example, I overlapped and cropped two copies of the same picture in order to color different portions of the image. Rather than deleting information in a picture file, though, PageMaker's cropping merely hides it, creating a document with an amazing amount of redundant data. Thus, although only half of each picture file will print ultimately, the printer must still process all of the information. With a true image-editing program you could create the same effect using only one picture—which would print in half the time.

PageMaker's image enhancement tools have limits, but if you're producing black-and-white or 2-color documents they give you powerful production controls for grayscale images and amazing

creative freedom for generating special effects.—*Luisa Simone*

Networking

NO-STRESS CABLING

TIP I enjoyed the item "Making Good Connections" in your September 13 column and agree that good crimp connectors provide a more solid physical connection than the twist-on type. We've used twist-on connectors successfully for about five years on my 100-node network, though—but I have two secrets. First, I use a good quality foam cable between the PC and the wall plate, which provides the resiliency to keep the connection strong. (Plenum cable must be used within walls and ceilings.)

Second, I use a bowtie in the cable to reduce the stress on the connector. This consists of wire ties that attach a loop of each cable to the T-connector, which keeps the physical load off of the connection between the T-connector and cable.

*Michael Lester
San Antonio, Texas*

PC MAGAZINE: I like your idea of taking the stress off the joint between the T-connector and cable, but many PCs I've seen don't have room in the back for a T-connector with a bowtie of cable attached. I also try to avoid tight radius bends in the coax because the center conductor can "flow" through the insulation over time. Hitchhiking on your idea, I'd suggest using cable ties to secure the cables to the PC, a desk, or a wall. Cable ties with a screw hole are common items and cheap insurance. Still, whether a connection is under stress or not, I'd bet my data on a BNC connector with a good crimp rather than a screw-on connector.—*Frank J. Derfler, Jr.*

Languages

READ FILE AND DIRECTORY NAMES IN QUICKBASIC

TIP An important capability that Microsoft QuickBASIC lacks is a method for reading filenames from disk. To pro-

vide a solution for this problem, I wrote two functions: FindFirst and FindNext. The FindFirst function expects two parameters, a file specification and a file attribute, and it returns the matching filenames one at a time in the order they occur on-disk.

The file specification can contain DOS wildcards (* and ?) and may also include a drive and path. If a matching file is found, these functions return -1 (True), and the filename is placed in a shared TYPE variable named DTA. The attribute lets you specify which type of files are to be located, using the following values:

```
&H0 - normal files
&H1 - read-only files (default)
&H2 - hidden files
&H4 - system files
&H8 - volume label
&H10 - subdirectories
&H20 - archived files (default)
```

To use these functions, you first invoke FindFirst to initiate the search. If FindFirst is successful, you can then use FindNext to find subsequent files. You may begin a new search at any time simply by invoking FindFirst with a new file specification.

The program in Figure 8 combines a demonstration with the FindFirst and FindNext functions, and it shows how to use these routines to read all files, including those with hidden, system, and read-only attributes.

You can download this program from PC MagNet's Programming Forum as FINDFI.BAS.

*Vincent D. O'Connor
Babbitt, Minnesota*

PC MAGAZINE: Although QuickBASIC provides no way to read filenames from disk, BASIC PDS includes the DIR\$ function for this purpose. However, DIR\$ is limited to regular files only, and it will not return the names of hidden or system files. Mr. O'Connor's FindFirst and FindNext routines do this. I took a few liberties with these functions and made changes to let them work with both QuickBASIC and BASIC PDS. I also added code to the demo portion of the program that shows how to return directory names alone.

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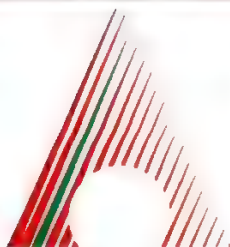


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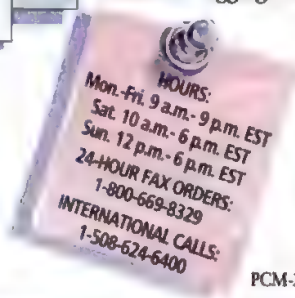


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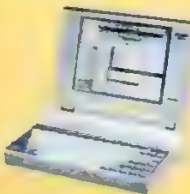
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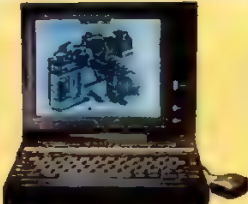
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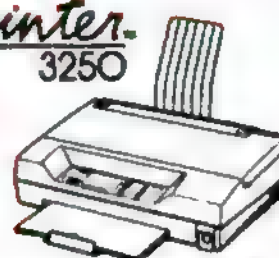
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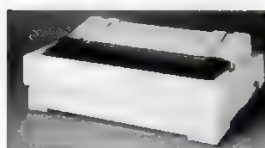


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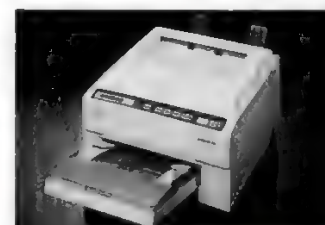
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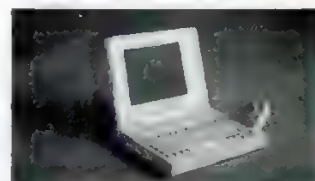
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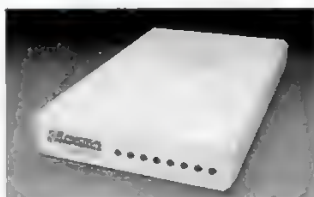
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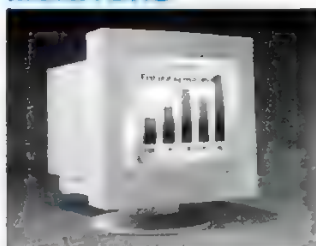
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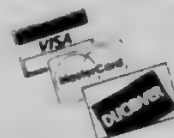
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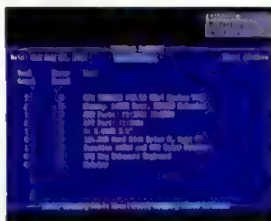
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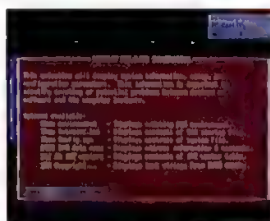
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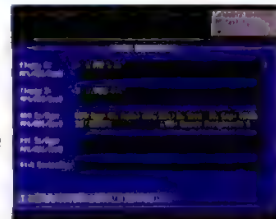
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CIRCLE 169 ON READER SERVICE CARD

FINDFILE.BAS

```

DEFINT A-Z

'SINCLUDE: 'QB.BI'

DECLARE FUNCTION FindFirst% (FileSpec$, Attribute%)
DECLARE FUNCTION FindNext% ()
DECLARE FUNCTION Trim$ (Work$)

TYPE DTAType
    Reserved AS STRING * 21
    Attribute AS STRING * 1
    DateTime AS LONG
    FileSize AS LONG
    FileName AS STRING * 13
END TYPE

DIM SHARED DTA AS DTAType
DIM SHARED Regs AS RegType

DirFlag = 0          'set to -1 to get directories
Attribute = 7        'match all file attributes
IF DirFlag THEN Attribute = 19

DO
    CLS
    LOCATE 2, 1, 1
    LINE INPUT "Enter a file specification: "; FSpec$
    PRINT
    NumFound = 0

    IF FindFirst%(FSpec$, Attribute) THEN
        DO
            IF DirFlag THEN          'for directories
                IF ASC(DTA.Attribute) AND 16 THEN
                    PRINT Trim$(DTA.FileName)
                    NumFound = NumFound + 1
                END IF
            ELSE                    'for regular files
                PRINT Trim$(DTA.FileName); TAB(17);
                PRINT USING "#####"; DTA.FileSize
                NumFound = NumFound + 1
            END IF
        LOOP WHILE FindNext%
    END IF

    PRINT : PRINT NumFound;
    IF DirFlag THEN
        PRINT "directories"
    ELSE
        PRINT "files"
    END IF

    PRINT
    PRINT "Find more files? (Y/N): ";
    YN$ = UCASE$(INPUT$(1))
    IF YN$ = "N" THEN END

LOOP
END

FUNCTION FindFirst% (FileSpec$, Attribute%)
    DIM FileSpecZ AS STRING * 80

    '---- Set up local disk transfer area
    Regs.ax = &H1A00          'Set DTA function
    Regs.dx = VARPTR(DTA)
    CALL Interrupt(&H21, Regs, Regs) 'call DOS

    '---- Call the DOS Find First function
    FileSpecZ$ = FileSpec$ + CHR$(0) 'DOS uses ASCII strings
    Regs.ax = &H4E00          'DOS Find First function
    Regs.cx = Attribute%      'specify attributes
    Regs.dx = VARPTR(FileSpecZ$) 'DX points to FileSpecZ$
    CALL Interrupt(&H21, Regs, Regs) 'call DOS

    FindFirst% = (Regs.flags AND 1) = 0 'True if found
END FUNCTION

FUNCTION FindNext%
    Regs.ax = &H4F00          'DOS Find Next function
    CALL Interrupt(&H21, Regs, Regs) 'call DOS
    FindNext% = (Regs.flags AND 1) = 0 'True if found
END FUNCTION

FUNCTION Trim$ (Work$)
    Null = INSTR(Work$, CHR$(0)) 'find the zero byte
    Trim$ = LEFT$(Work$, Null - 1) 'return all to the left
END FUNCTION

```

Figure 8: This program demonstrates two functions you can use to read all files, including those with hidden, system, and read-only attributes.

The file attribute parameter tells these functions which types of files to include, based on the values given above. These attribute values are additive, so to include files that are either hidden or system, use `Attribute% = 7 (4 + 2 + 1)`. Note that attributes marked (default) need not be specified, so archive and read-only files are returned even if those values are not added to `Attribute%`, as are files that have no attributes set.

In order to read directory names, you must add 16 (&H10) to the attribute value, which instructs DOS to include both file and directory names in the search. However, you must then test the attribute byte to filter out names that are not directories. This is shown in those parts of the program that test the variable `DirFlag`.

`FindFirst` can also tell you whether a single file exists. For example, the following line

```
IF FindFirst%('C:\MYFILES\
FOO.BAR') THEN ...
```

determines whether the file `FOO.BAR` exists in the `MYFILES` directory on your `C:` drive.—*Ethan Winer*

Utilities

UPGRADING ULTRAVISION

For many years I used an EGA monitor and card. To enhance the performance of the EGA, I used the UltraVision software from Personics. Recently, I upgraded my system with a new multiscanning monitor and card. But I can't use the software with my new monitor because UltraVision only works with EGA and VGA (640-by-480).

One feature of UltraVision I particularly liked was its ability to enhance the `DIR` command by color-coding the file extensions. Each type of file could be displayed in a different color; for example, `.COM` files in green, `.EXE` in yellow, `.BAT` in blue, and so forth. This made it easy to pick out the various types at a glance.

Is there any utility available that can do the same thing?

*Shraga Ilin
Holon, Israel*

► **PC MAGAZINE:** Good news! You don't have to abandon UltraVision; just upgrade to the latest version, which works with almost any EGA or VGA board. Version 2.12 comes in three different styles, Laptop UltraVision, Desktop UltraVision, and UltraVision Extended Edition. The color-coding feature is provided by the ancillary program `DE` (Directory Expander), which is included only in the Extended version. Registered UltraVision users can upgrade for \$15 plus \$3.75 for shipping and handling.

The `DE` program is intimately related to the DOS version whose `DIR` command it enhances. If you own a copy of UltraVision that predates DOS 5.0, you'll find your copy of `DE` doesn't work under DOS 5.0. Call Personics (508-658-0040) for a great deal on a DOS 5.0 upgrade for `DE` alone.—*Neil J. Rubenking* □

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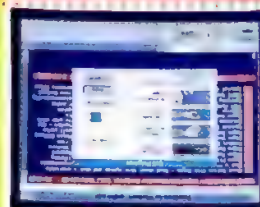


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NETWORKING

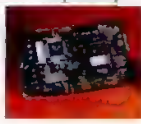
Artisoft/Lantastic
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SOFTWARE

w = Windows Software

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DAC Bonus Pack 4.3	119
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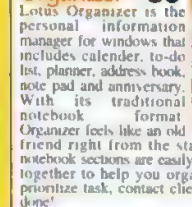
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Microsoft Access \$89



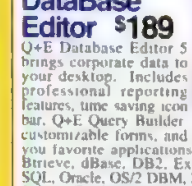
Microsoft Access is the relational database management system for the Windows operating system. Access data quickly using graphical query-by-example. Includes an integrated development environment with a full suite of debugging tools. Read and write foreign desktop data concurrently including dBASE III PLUS & dBASE IV, Paradox 3.0 & 3.5 and Btrieve formats. Special introduction price while supplies last.

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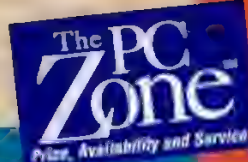
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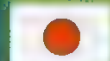


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Bravo 486	2Meg Kit	500987-001	99.00
	4Meg	500987-002	159.00
	8Meg Kit	500987-003	318.00
	16Meg	500987-004	599.00
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Premium 386/25. 16 SX	1Meg	500718-001	55.00
Premium 386/33	1Meg	500718-002	56.00
Premium II	1Meg	500780-003	WPB 60.00
386SX20, 486-25. 25E. 33	4Meg	500780-004	WPB 149.00
Premium Tower, 386/33TE. 8Meg	8Meg	500780-001	WPB 298.00
486/25TE, 486/33TE			

ZENITH MEMORY UPGRADES

MODEL#	AMT. UPGRADED	ZENITH PART#	PRICE
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Z386/33, 25, 20, 33E	4Meg	ZA3800MK	149.00
Z248, Z286LP Z386SX	2Meg	Z 60S-1 modules	99.00

MAGNAVOX

286/386SX-16, 386SX-20,	420 425 433 450 DE, SE, TE
486SX-20 & 386-33	2/4Meg Kit — 129.00/199.00
all are 72PIN SIMM	8/16 Meg — 319.00/619.00
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6450379 (2Meg)	80-111, 311-121, 321 081, 161	89.00
6451060 (4Meg)	80 A21, A-61, 80 A31, 80-111, 80-311	179.00
6450603 (1Meg)	35SX, 40SX, 55SX, Model-70 s, P-70	54.00
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	55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	
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	Value Point 325T	
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6450128 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC	149.00
	P/S1, 386SX, Models-2123, 2133, 2155	
	Value Point 77 486DX2, 486SX, SVR 85	
6450129 (8Meg)	35SX, 40SX	289.00
6450130 (8Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC	289.00
	Value Point 77 486DX2, 486SX, SVR 85	
79F0999 (2Meg)	LX40, N33SX, PS Note	89.00
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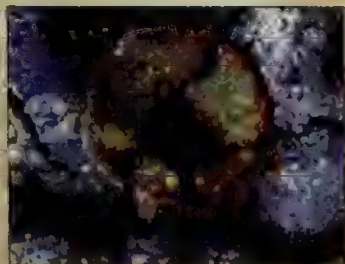
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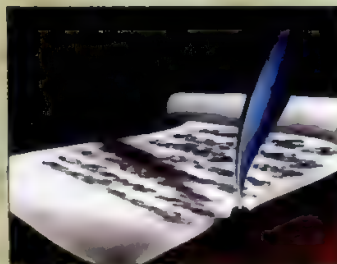
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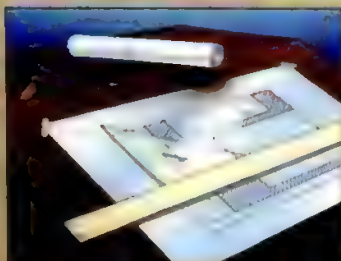
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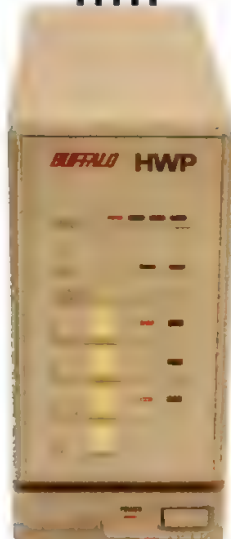
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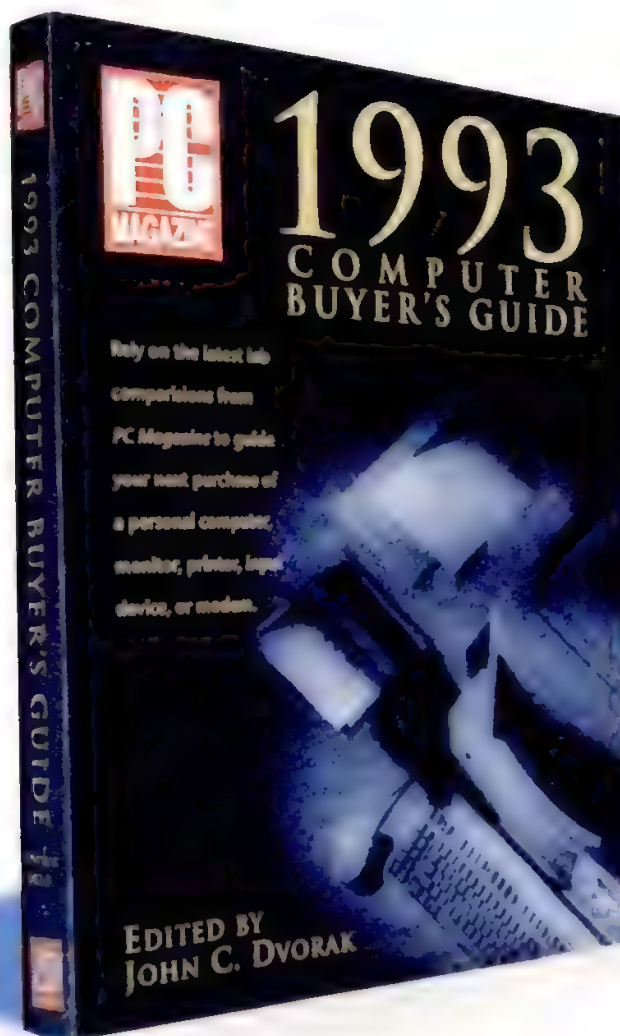
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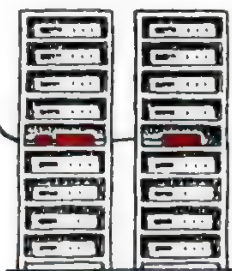
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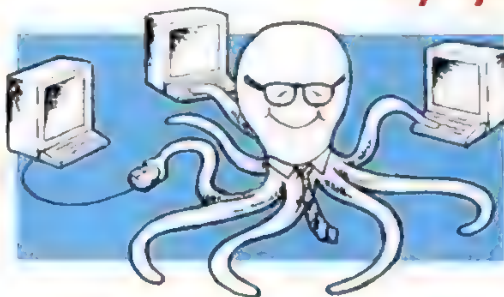
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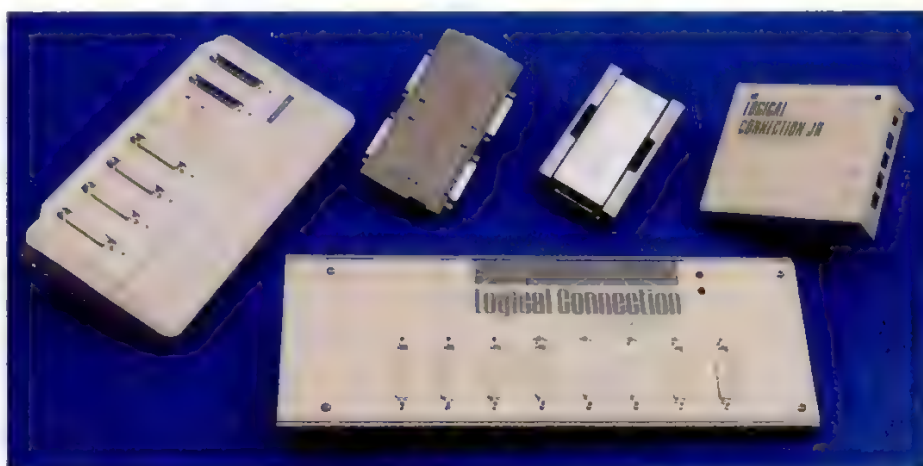
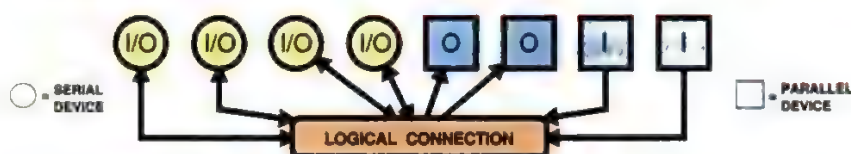
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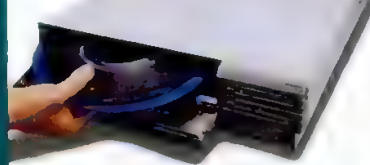
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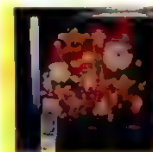
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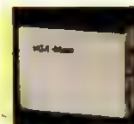
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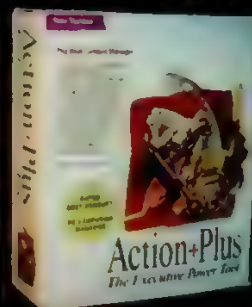
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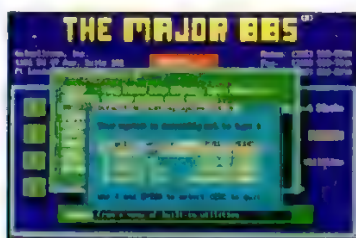
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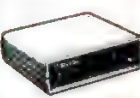
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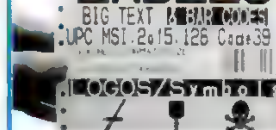
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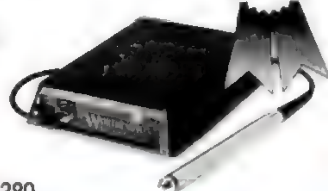
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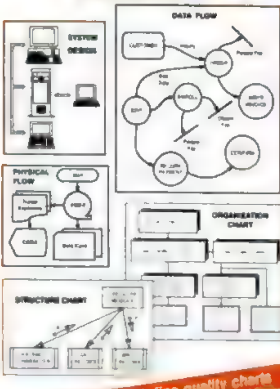
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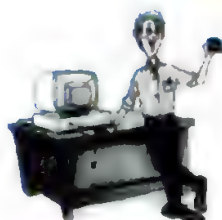
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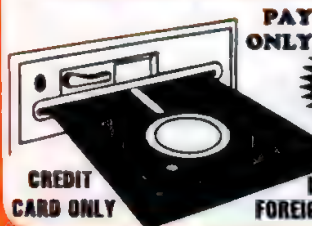
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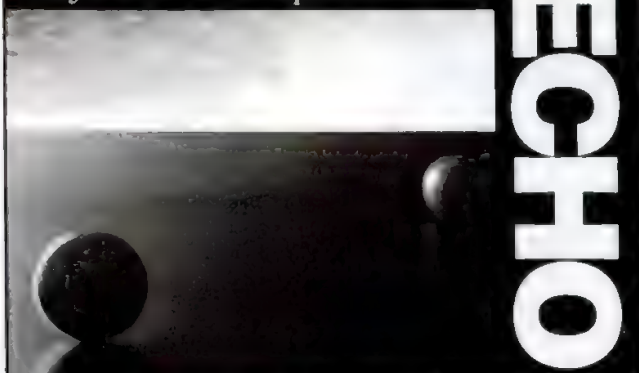
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1. Do you work in a DP/MIS dept.?
01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity: (Check one only.)

01. ☐ Manufacturer Computer Equip., Computers, Software
02. ☐ Manufacturer—Aerospace
03. ☐ Manufacturer—Other
04. ☐ Systems House
05. ☐ Computer Consultant
06. ☐ Computer Retailer/VAR/VAD Distributor
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11. ☐ Government—Non-Federal
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14. ☐ Health/Medical/Legal Service
15. ☐ Engineering/Architecture

16. ☐ Agriculture/Construction/Mining/Oil/Transportation/Utilities
17. ☐ Non-Computer Retailer/Distributor
18. ☐ Other Business or Service

3. Please indicate your primary business function: (Check one only.)

01. ☐ DP/MIS
02. ☐ Systems, Programming
03. ☐ Communications
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14. ☐ Admin./Mgmt.
15. ☐ Other

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

01. ☐ 10 or less 03. ☐ 26-99
02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office? (Check all that apply.)

01. ☐ Linked to mainframe
02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply.)

01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

8. Do you plan to buy any PC products?

01. ☐ Now 03. ☐ In 7 to 12 months
02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of Employees in your entire company:

01. ☐ 25 or less 02. ☐ 26-99 03. ☐ 100-499 04. ☐ 500-999 05. ☐ 1000 or more

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1. Do you work in a DP/MS dept.?

01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity: (Check one only)

- 01. ☐ Manufacturer/Computer Equip., Computers, Software
- 02. ☐ Manufacturer-Aerospace
- 03. ☐ Manufacturer-Other
- 04. ☐ Systems House
- 05. ☐ Computer Consultant
- 06. ☐ Computer Retailer/VAR/VAD Distributor
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- 11. ☐ Government-Non-Federal
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- 14. ☐ Admin./Mgmt.
- 15. ☐ Other

4. Is your company a reseller?

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5. For how many IBM PCs and compatibles do you specify brands of products:

- 01. ☐ 10 or less 03. ☐ 25-50
- 02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

(Check all that apply.)

- 01. ☐ Limited to mainframe
- 02. ☐ Limited to mini
- 03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply.)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Minis
- 04. ☐ Macintosh
- 05. ☐ CD-ROM
- 06. ☐ Windows

8. Do you plan to buy any PC products?

- 01. ☐ Now 03. ☐ In 7 to 12 months
- 02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of Employees in your entire company:

- 01. ☐ 25 or less 02. ☐ 26-50 03. ☐ 100-499 04. ☐ 500-999 05. ☐ 1000 or more

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Coming Up

14- and 15-Inch Monitors

Whether you are a DOS user or a budget-minded Windows user who can't afford a 16- or 17-inch display, there is a 14- or 15-inch monitor for you. *PC Magazine* looks at nearly 60 14- and 15-inch displays that meet or exceed the VESA refresh rate requirement of 72 Hz at a resolution of 800 by 600.

Antivirus Software

One year after the Michelangelo virus, viruses are still very much alive. Improved scanning, detection, cleaning technologies, and—on the horizon—network solutions all help allay our fears. To help you cut through the myriad of choices available, *PC Magazine* looks at more than 20 virus-protection products and the environment that makes them necessary.

Debugging Tools

There are a wide variety of different tools for helping programmers debug their programs. But why go out and buy a debugger when virtually all compilers come with debuggers? This story takes a close look at the special strengths of the tools available.

Linking LANs into WANs

Local area networks are rapidly expanding. As more businesses recognize the need to exchange data among distant offices, more LANs are being linked together into wide-area networks. *PC Magazine* explores the latest, fastest, and most cost-effective options for interconnecting LANs, including leased lines, T1, packet-switching networks, X.25, switched 56, ISDN, frame relay, and ATM.

High-End Illustration Software

For artists, graphic designers, and desktop publishers, illustration software that works with easily scalable vector files is the answer to many an illustration requirement. *PC Magazine* reviews six programs that offer an abundance of drawing, editing, and other creative tools under DOS, Windows, or OS/2.

Free Utility

If you're an in-house developer, a shareware author, or just a casual programmer, PC-SETUP, next issue's utility, is an efficient and economical way to distribute your programs and updates to your users. It lets you distribute up to 99 disks, each with 19 .ZIP files, and indicate which files are required. Best of all, even the inexperienced can install programs with PC-SETUP. □

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FANTASY FOLLOW-UPS

With Four New Sequels, Computer Role-Play Games Live On

BY BARRY BRENESAL

Some people can't get enough of a good thing. The Corleones, Freddy Krueger, and The Terminator all promise, "I'll be back," and to the delight of their fans, they return to new adventures and new box office success.

The same holds true for computerized fantasy role-playing games. As in the movies, sequels hold advantages for both sides.

The need to compete for an ever-more sophisticated market has rendered the cost of completely new software games nearly prohibitive. But game sequels allow developers to build new and updated products on existing software engines and audience expectations. This virtually guarantees lower expenses and a shorter development cycle.

For the players, sequels create an opportunity to continue adventures with characters and settings they have grown to love. Both developers and players can enjoy the security of a tried-and-true predecessor.

In this review, we look at four recent fantasy role-playing releases: Castles II, King's Quest VI, Might & Magic, and Wizardry VII. All four games feature 256-color VGA graphics and can harness extended and expanded memory to

make game play much faster than that of earlier products. Castles II and Wizardry VII feature new interfaces, engines, and features, but they maintain their links with earlier games.

Players need not have played the earlier games in the series; in fact, only Wizardry VII gives players the option of importing a character from one of the older games. These four products will both delight fans and win new converts.

INTERPLAY
PRODUCTIONS INC.

Castles II: Siege & Conquest

Castles II: Siege & Conquest is a complete rewrite of the original Castles with far greater emphasis on strategy and resource allocation and a number of added features, such as digitized video clips and an enhanced soundtrack.

The setting, as in the original Castles, is Bretagne, a kingdom patterned after fourteenth and fifteenth century France. After the heirless ruler dies, five claimants to the throne arise, each of varying fortune and personality. You play one of the characters; the computer handles the other four.

Your goal is simple enough: You must get

the pope to recognize your claim to the Bretagnese throne. The means to achieve this are necessarily more difficult. You will have to build and defend your castle, forge alliances, and attack your enemies to win the game.

The artificial intelligence that drives Castles II differentiates the royal aspirants effectively. Duke Phillip of Burgundy is, as another claimant says, a political weasel with a singular talent for diplomacy and not much else. King Edward of Albion is self-righteous and at odds with church and family, but he is an effective administrator. Whichever character you select inherits a complicated tangle of relationships with the other pretenders to the throne—not to mention the pope, peasants, nobility, and several important secondary figures.

BUILD, ATTACK, NEGOTIATE

All your potential game actions are broadly gathered into three color-coded task categories: administrative, military, and political. The first includes gathering resources and building castles. In military tasks, you recruit

different fighting units, attack other lords, and send saboteurs. Political tasks are the most diverse, including the machinations of diplomatic envoys, merchants, spies, and scouts.

When you choose the Build Castle option, the game switches to an isometric design screen for palatial real estate development. Progress can be monitored anytime, revealing nearly a dozen different specialized groups of workmen. It's fascinating, like watching medieval SimCity residents, oblivious to your omnipotent presence, making decisions.

You allocate points to any given task; the number of points determines the task's chance of success and the speed of performance. Bar graphs display the results of up to six tasks running simultaneously. If that doesn't keep you busy enough, toggle the Plots option on and confront a gamut of difficult situations with multiple-choice solutions. Your answers to these questions affect the way your character is viewed.

LIFELIKE BATTLES

Battles also take place in Bretagne. The game's controls are very easy to use and the results are surprisingly lifelike. You'll get the chance to combine infantry, archers, and knights with various attack options and the latest in scientific assault weapons—siege towers, catapults, and ballistae. You can bypass tactical combat altogether and await the outcome, but



Castles II is a complete rewrite of the original, set in the kingdom of Bretagne.

Castles II

troops behave much more efficiently under your vigilant gaze.

When you choose to enter battle, a digitized video clip appears in a corner of the screen. The tiny 1-inch-square clips (taken from two public domain movies: *Alexander Nevsky* and *The Private Lives of Henry VIII*) are a fresh idea, but they're more gimmicky than game enhancing and eat up nearly 7MB of hard disk space if you choose to install them.

Diplomacy is Castles II's weakest suit. Though you can send gifts to other powers and improve relations, there are no options to reflect a broader range of realities, such as bribing another character to lower an opponent's standing with a third ruler or forming and breaking alliances with extra rewards and penalties attached.

Regardless, Castles II is a colorful and unique fantasy role-playing game that com-



Might & Magic: This is the easiest adventure, but an enjoyable journey through the artists' imaginations.

bines intriguing plot episodes, a delightful soundtrack, strategic considerations, and relatively realistic battles. No two sessions are alike; each is a fresh challenge. It offers the possibility of gaining a crown and presents the contemporaneous reality of many enjoyably wasted hours.

Castles II: Siege & Conquest, \$59.95. Requires: 640K RAM, 11MB hard disk space, DOS 3.1 or later; mouse recommended. Interplay Productions Inc., 17922 Fitch Ave., Irvine, CA 92714; 800-969-4263, 714-553-6655; fax, 714-252-2820.

Circle 458 on reader service card

SIERRA ON-LINE

King's Quest VI: Heir Today, Gone Tomorrow

King's Quest VI: Heir Today, Gone Tomorrow is the latest release in Sierra On-Line's flagship series, with an opening animated sequence that takes 6MB of hard disk space. Here, the vocal acting and the simulated camera angles are poor and the digitized voices out of sync, but matters improve greatly once you move into the game itself and take over the persona and the predicaments of young Prince Alexander.

The prince has been shipwrecked on the Green Isles, which is home to his own true love, a princess that he met years ago. There he finds her about to marry a distinctly shady vizier after the sudden death of both of her parents. The Green Isles themselves are in an uproar over stolen valuables, which have created rampant xenophobia among the inhabitants of each of the four isles.

ILL-FOUNDED SUSPICIONS

It's no secret, of course, that the inhabitants' suspicions of one another are ill-founded.

The implied message—here, and in another recent Sierra sequel, *Hero's Quest III*—is that talking about problems sometimes works to better advantage than do fear and war's devastation. Fortunately, Sierra has chosen to convey these sentiments through the plot rather than by preaching them. In a gaming world that has seen several recent releases that equate gore and sexual violence with fun, Sierra's policy is a highly commendable one.

Time after time, King's Quest VI demonstrates a Disney-like visual imagination: occasionally brilliant and never pretentious or artsy.

HOMAGE TO CARROLL

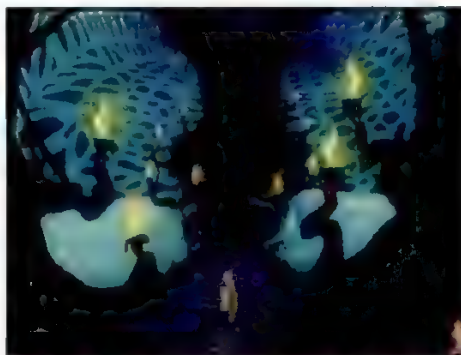
Each isle, for instance, holds fond memories of fantasy drawn from other genres. The Isle of Wonder clearly pays homage to Lewis Carroll's *Through the Looking Glass*, with bickering chess pieces and an anthropomorphic garden. As you might expect, the Isle of the Beast reproduces the darksome fairy tale *Beauty and the Beast*, with nods to both the feature-length Disney cartoon and the more imaginative Jean Cocteau film of the 1940s.

Austere, intellectual bird-people occupy a third isle. The royal castle is on a fourth, curtailed by guard dogs who are far more guard than dog (and are captained by a sleek, semihuman Russian wolfhound).

Like most graphics adventures, the King's Quest series concentrates upon visual relationships—whether simple

object associations or complex verbal/visual puns. Of course, the game has its share of just plain awful word puns, too. To the folks at Sierra On-Line, this kind of wordplay torture is second nature.

In one significant, behind-the-scenes way, King's Quest VI differs considerably from its predecessors: memory us-



King's Quest VI: Heir Today, Gone Tomorrow is marked by a Disney-like visual flair.

age. The game's ability to use both extended and expanded memory makes screen switching occur much faster than it did in earlier Sierra On-Line products. As in the company's other games, the interface is icon-driven and very simple to use. Nonetheless, you will definitely want to use a mouse when you're playing the game.

King's Quest's latest sequel may be more of the same, but that's no cause for concern. A formula that's rooted in the likes of Perrault and the Brothers Grimm needs no excuse for its theme. And with Sierra at the design helm, it also needs no apology for its treatment.

King's Quest VI: Heir Today, Gone Tomorrow, \$79.95.

Requires: 640K RAM, 18MB hard disk space, DOS 3.0 or later; mouse recommended. Sierra On-Line, P.O. Box 485, Coarsegold, CA 93614; 800-326-6654, 209-683-4468; fax, 209-683-3633.

Circle 460 on reader service card

Might & Magic: The Clouds of Xeen

The Might & Magic series is in some ways similar to Sir-Tech Software's Wizardry series. Each offers an animated landscape, auto-mapping, 256-color VGA screens, dark dungeons, and luminous quests. Parties of six characters representing disparate professions sally forth in both series, facing terrible evils and enormous odds.

There, however, the similarities end. While Wizardry's universe has always been tough going, Might & Magic's challenges have mellowed with the passage of years and follow-ups. Might & Magic: The Clouds of Xeen is the fourth and easiest in New World Computing's series. In this story, the adviser to Xeen's young, earnest-but-mediocre king has been kidnapped; you are charged with both freeing him and confronting the kidnapper.

Some fans may even find the game too easy, with few puzzles to bedevil the novice adventurer. There are still plenty of dungeons and towers to explore, of course, and an enormous menagerie of villains to defeat in a gradual, almost leisurely way.

That's fine; there's no reason to rush in Xeen and only the simple plot to follow. Instead, this game should be played for its innate heroics and enjoyed as a free ride through the imaginations of New World Computing's artists.

A DELIGHTFUL TOUR

If you're a fan of the series, you'll enjoy the tour. Xeen's landscape and townsfolk are brilliantly colored and charmingly diverse. More than 80

■ Clue Books: *Play and Win*

Popular games create a need for clue books—everything from slim but cleverly written pamphlets to respectably sized tomes. The books that walk players through King's Quest VI, Might & Magic, and Wizardry VII provide everything from interviews with the game designers to answers to puzzles.

The Official Book of King's Quest (\$16.95), by Donald B. Trivette, covers all the quests in the Sierra On-Line series. Its author's teasing, nonintrusive sense of humor complements the game itself. Good as Sierra's hint lines are, Trivette's official guide has all the games and clues in one place and a master to scout the tortuous, delightful way. (Compute Books, 324 W. Wendover Ave., #200, Greensboro, NC 27408.)

The Might & Magic: Clouds of Xeen Clue Book (\$19.95), by Paul Rattner, features hints for both beginners and experienced players. This account of the game has dozens of black-and-white illustrations and descriptions of the monsters, spells, and dungeons. (New World Computing, P.O. Box 4302, Hollywood, CA 90078.)

The Crusaders of the Dark Savant Playmaster's Compendium (\$19.95) helps players solve the Wizardry VII mystery. Written by Brenda Garno, the author of the game's detailed and humorous documentation, this clue book features all the text, maps, and inventories of items and monsters found in the game. An interview with the developer and advice on strategy from players complete this guide to the challenging adventure. (Sir-Tech Software, P.O. Box 245, Ogdensburg, NY 13669.)—Barry Brenesal □

different animated monsters appear in visual styles as unrelated as Tex Avery and Claymation. Never mind that these creatures are trying to kill your party; it's just a pleasure to watch them.

As in previous Might & Magic releases, the characters in Xeen gain most of their experience points by successfully performing mini-quests. There are plenty of these available, and they contain very few restrictions. Roam wherever you want. You'll find endless opportunities to pick up information, garner wealth, perform valuable services, and get severely injured in the process.

Of all fantasy series, Might & Magic has best retained a

sense of humor that rides above the story and never takes itself very seriously. When creator Jon van Caneghem's love of wordplay comes to the fore, for instance, the phrase "Flying Feet" turns into a vicious, surrealistic reality. More of this humor would be welcome and rather less of the orcs, kobolds, trolls, gnomes, and other horrific riffraff that occur throughout fantasy fiction and software with terrifying regularity.

The game makes passing reference to "The Dark Side of Xeen." You can't travel there, and there's a perfectly good reason: It's the setting for the next Might & Magic adventure, scheduled for release in the winter of 1993. Because

they use the same engine, both *The Clouds of Xeen* and *The Dark Side of Xeen* can be played separately or joined together. In the latter case, there's a third ending sequence, totally different from the ending sequence of either game on its own. It's a nice touch, but unnecessary in a product this well crafted and visually entertaining.

Might & Magic: The Clouds of Xeen, \$69.95. Requires: 2MB RAM, 15MB hard disk space, DOS 3.3 or later. New World Computing Inc., 20301 Ventura Blvd., #200, Woodland Hills, CA 91364; 800-325-8898, 818-999-0606; fax, 818-593-3455.

Circle 459 on reader service card

SIR-TECH SOFTWARE INC.

Wizardry VII: Crusaders of the Dark Savant

Wizardry I: Proven Grounds of the Mad Overlord arrived on the PC game scene in 1981. But while the PC's sophistication developed over time, Wizardry didn't—two-color wire-frame dungeons figured in the fifth sequel, released in 1989. Sir-Tech Software made some major product enhancements to 1991's Wizardry VI series, but Wizardry VII: Crusaders of the Dark Savant, is truly state-of-the-(current) art, with 256-color VGA screens and 3-D graphics.

EXTENSIVE VARIATIONS

Structurally, Crusaders remains a much-extended variation on standard role-playing games. Each of your 6 team members is rated on 8 personal attributes and up to 34 potential skills. These skills increase through experience (battles and quests successfully completed). There are 14

Wizardry VII

Wizardry professions to choose from while designing your party. Some characters are proficient in the martial arts or the finer aspects of lock picking; others are proficient in many of the game's 96 individual spells.

FIRST-PERSON VIEWPOINT

All of this information is presented on a character-ratings screen with particularly appealing artwork. Elsewhere, Crusaders adopts a first-person, 3-D viewpoint, which looks most impressive when you're fighting the animated groups of monsters your party continually encounters.

All the more jarring, then, are the occasional blank screens you happen upon, accompanied by some florid description of what you can't see.

It's almost as if a ghost of Wizardry's old nonvisual approach still lurks occasionally around this edges of this version of the game.

When it comes to an interesting, complex plot, Crusaders handily beats the rest. The story takes place on a fabled and recently discovered planet, Lost Guardia, whose grounds are now stalked by seven different alien species on a search for a secret of universal proportions. Nobody knows what the secret is, but they will know it when they see it, and so will you.

The interplanetary races you encounter evince different philosophies; individual members have their own spin on those philosophies. Pick your alliances wisely, because

you'll probably be picking up enemies at the same time.

The idea of seven forces competing with seven different goals is well defined and cleverly exploited in several

you can actually lose to any of the program-directed competitors; no two games ever play exactly alike.

Wizardry VII: Crusaders of the Dark Savant gets high marks for its humor, its excellent characterization, and its thorough and well-detailed documentation. Likewise, Sir-Tech's technological leap forward is worthy of praise. □



Wizardry VII includes challenging puzzles and has technological gains over earlier Wizardry games.

Wizardry VII: Crusaders of the Dark Savant, \$69.95.

Requires: 640K RAM, 5MB hard disk space, DOS 3.0 or later; mouse

recommended. Sir-Tech Software Inc., P.O. Box 245, Ogdensburg, NY 13669; 800-447-1230, 315-393-6451; fax, 315-393-1525.

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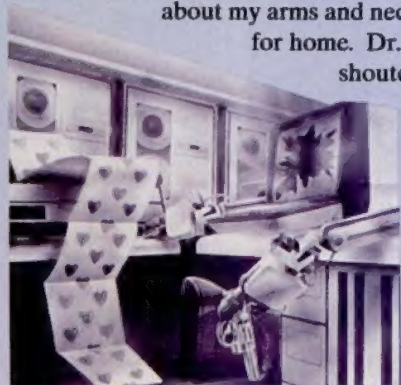
Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Robin Raskin

10 YEARS AGO IN PC MAGAZINE

"Oblivious to all else around me, I reeled up the tangled yards of paper ribbon from the floor, draped them in coils about my arms and neck, and departed for home. Dr. von Kleigstadt shouted that I was fired for having left EPICAC on all night."



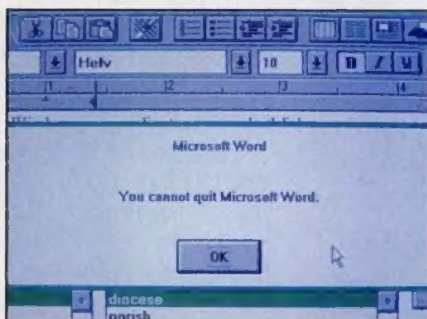
for having left EPICAC on all night."

—KURT VONNEGUT, JR., WRITING ABOUT WHAT HAPPENS WHEN A YOUNG COMPUTER'S FANCY TURNS TO THOUGHTS OF LOVE

Microsoft Carries the Big Brother Thing Too Far

Try this on your system:

1. Load Windows.
2. Load WinWord.
3. Open the Thesaurus.
4. Press Alt-Tab to return to the Program Manager.
5. Press Alt-F4 to exit Windows.



A Realization

"I finally realized why Windows is truly multitasking. I find myself keeping some secondary task (like reading my mail) handy so I can make good use of the time I spend waiting for Windows."

—STEVE EDELSON

Does the Material Girl Shop at Egghead?

Madonna's been showing up all over the place recently—even in some of your favorite computer magazines:



Jain McKell/Retna Ltd.

"To paraphrase Madonna in her magnum opus *Truth or Dare*, anyone who thinks the Teach-Text icon is 'neat' has got to go."

—MACUSER

"No, not Madonna and Sean. We're talking about the long-running spat between IBM and Microsoft."

—COMPUTER SHOPPER

"A database of research in microbiology will never sell as well as Madonna's latest album and will never be as inexpensive."

—PC SOURCES

"None of these full-motion video alternatives will put Madonna videos on your 200MB hard disk."

—PC MAGAZINE

BUZZWORD WATCH

bumpable technology

The ability to add users and capabilities in small affordable bumps.

First heard: *Calculus Inc. press release touting EZ-Fax's bumpable networked Version 3.6.*



RICHARD TENNANT

If your entry is used in *Abort, Retry, Fail?* we'll send you \$50 and a *PC Magazine* T-shirt. Winners this issue: Ben Gottesman (Microsoft calls the shots), Steve Edelson (multitasking), Don Willmott (Madonna retrospective).

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Source: Reliability Ratings™, 1992 PC Vendor Survey

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1. DELL (6.53)	1. DELL (6.58)	1. DELL (6.62)	1. DELL (6.56)	1. DELL (6.55)	1. DELL (6.73)	1. DELL (6.31)	1. DELL (6.77)
2. APPLE (6.08)	2. IBM (7.38)	2. COMPAQ (6.62)	2. COMPAQ (6.55)	2. APPLE (7.84)	2. COMPAQ (6.62)	2. APPLE (6.08)	2. COMPAQ (6.48)
3. IBM (6.01)	3. APPLE (7.72)	3. APPLE (6.58)	3. APPLE (6.58)	3. COMPAQ (7.48)	3. APPLE (6.43)	3. COMPAQ (7.83)	3. APPLE (6.14)
4. COMPAQ (6.53)	4. COMPAQ (7.71)	4. IBM (6.21)	4. IBM (6.54)	4. IBM (6.21)	4. IBM (7.88)	4. IBM (7.38)	4. IBM (7.58)

Survey was independently conducted by Reliability Ratings, Inc., a subscriber-based research firm that does business with most of the FORTUNE 500®

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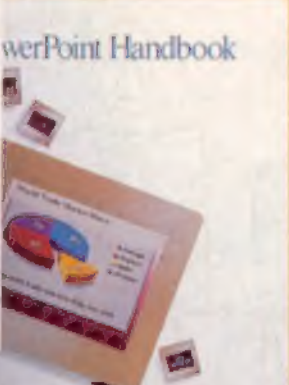
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